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Modern Baking Powder

JUANITA E. DARRAH

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MODERN
BAKING
POWDER



Cereals Contain Phosphate and Aluminum

Modern Baking Powder

an Effective, Healthful
Leavening Agent

Including

The occurrence of aluminum compounds
in foods and their effect on health.

Compiled by

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CALUMET BAKING POWDER COMPANY

Chicago, Illinois

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Preface

ANY have asked questions regarding the effect on health of foods prepared with baking powder. Answers have frequently been sought from those who have made little or no study of the facts relating thereto.

The pertinent facts necessary for the formation of an intelligent opinion have never been presented in a form sufficiently full and, at the same time, sufficiently brief and free from highly technical matter, to be acceptable to the non-technical public. This book is an attempt to fill such a need. The writer believes that the facts here gathered together will be new and interesting to the general public and to many physicians.

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Chapter I

THE CAUSE OF A CONTROVERSY

The public has welcomed the improvements in baked products due to the improvements made in the baking powder itself. The new combination powders have dominated the market even without National advertising. The whole industry has prospered and the consumption of Baking Powder is now over 300 tons per day.

This wonderful advance has not been brought about by the united efforts of the whole industry. On the contrary, there has never been a modern industry in whose growth there was less union of effort, or more independence of action and more individual and business antagonism. The business is made up of individual firms and corporations, manufacturing independently, investigating independently and selling in bitter competition. Officers and scientists representing these manufacturers meet accidentally, if they meet at all, at gatherings of associations, of which they constitute a very small part, but they have no association



Strawberries Contain Phosphate and Aluminum

representing the whole industry and there is no active association representing any part of the industry. Some are content with praising their own goods and meeting competition with reduced prices. Others prefer by slander to install a fear of their rivals' powders in the mind of the consumer, at the same time holding to their own high prices. The slandered naturally seek to defend themselves and sometimes retaliate. This strife in the industry involving the expenditure of millions of dollars is broad in its scope and extends from the effort to sell a single consumer and to win the good will of a single scientist, to attempts to obtain special legislation in the states which would injure or destroy their competitors and even to our National laws and their enforcement.

The general interest of this story, however, cannot be fully appreciated without knowing something more about the baking powder itself, what takes place when it acts in leavening biscuits and cakes, and what other effect than leavening it has on the food.

The facts one needs to know are simpler and more interesting than is the making of a cake. The ingredients will be discussed here.

There are altogether only seven different materials used in making all the baking powders in the United States. They are as follows:

Baking Powder Ingredients:

1. Soda
2. Starch
3. Dried White of Egg
4. Acid Potassium Tartrate (Cream of Tartar)
5. Calcium Acid Phosphate
6. Sodium Aluminum Sulphate
7. Tartaric Acid.

Three of these are already familiar substances and so only a thought is necessary on each of them.

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Soda, or baking soda, which is the same thing, is no different in baking powder from that which is used in the home. The housewife and the baking powder manufacturer use the same identical substance. All the manufacturers use this same soda. True, some use it in a finely powdered form, others use a form not so fine, which is called "granular soda." There is no more difference between granular soda and powdered soda than there is between granulated sugar and powdered sugar. Soda is the purest chemical found in com-



Cherries Contain Phosphate and Aluminum

merce. Since all manufacturers of baking powder use this same pure substance, they do not quarrel over it, though some use it as a fine powder while others use it in a granular form. Those using the granular soda, for which they pay a premium, are convinced that it makes the baking powder keep longer, as the larger particles have less contact with the other ingredients in the can. It is one of the most important ingredients of the baking powder because it contains, chemically combined, all the leavening gas later to be liberated. However, since there is no serious disagreement on this point, it is here only of passing interest.

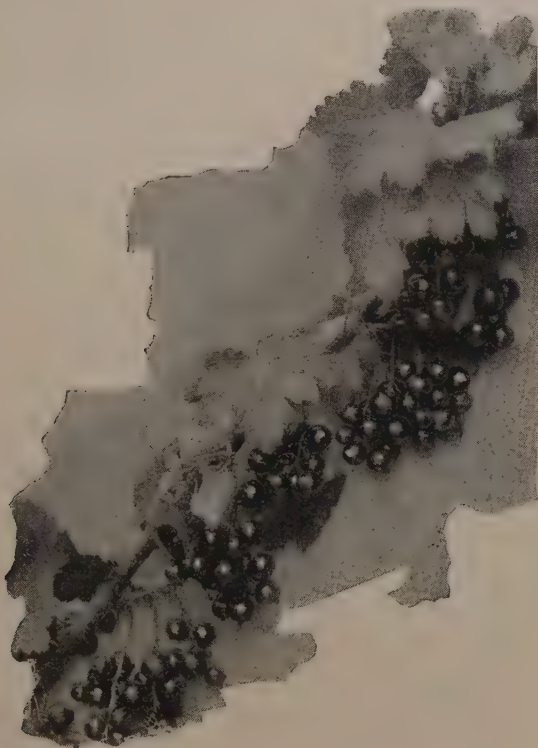


Bananas Contain Phosphate and Aluminum

There is but one difference between the starch used by the housewife and that used by the baking powder manufacturer. The difference is in its dryness. The starch used in the home contains from 10% to 12% of water. That used by the baking powder manufacturer contains no more and may contain considerably less. Those most jealous of the reputation of their product will not use starch containing more than 5% of water; while others are satisfied with 7%, and some with 10%, as in the household article. The starch containing a smaller amount of water is more costly, since it not only requires more corn to make 100 lbs. of it, but also because it requires a longer drying. Cornstarch is a wholesome edible substance. All baking powder manufacturers use it. Those using the redried product do so because experience has shown that baking powders made with it instead of with ordinary starch keep longer and therefore remain fresher, and more capable of giving off an abundance of gas to generously leaven and lighten the cake. Baking powder manufacturers have not quarreled over these differences.

EFFICIENT AND HEALTHFUL

Some, but not all, baking powder companies use a small amount of dried white of egg as an ingredient in baking powder. It has been estimated that about $\frac{1}{4}$ of the manufacturers use this ingredient. It should not be confused with the name egg albumen, which is the name applied to partially dried egg whites as imported into this country. Egg albumen is generally imported in the form of transparent, amber colored, flakes, but it contains about 15% of water. This water must be removed before one can properly grind it, and the re-



Currants Contain Phosphate and Aluminum

removal of the water gives us the really dry white of eggs. The eggs used to prepare this product are hens eggs. The amount of dried white of eggs when used in a baking powder is generally about 15/100 of 1%. As stated on the label of some powders "The dried white of eggs furnishes a means of estimating the amount of gas in the powder and is not a substitute for eggs in cooking." Egg albumen is a wholesome desirable substance in baking powder foods. This is not questioned.

The other four ingredients, Cream of Tartar, Calcium Acid Phosphate, Sodium Aluminum Sulphate and Tartaric Acid, are all used for the same purpose—that is, to liberate the leavening gas (carbon dioxid). Strictly speaking, there is no gas in the baking powder. It is composed entirely of little solid particles of soda, starch, etc. But gas is set free from the solid soda when used in baking. It can be made from soda alone. No other substance need be added. The whole of the soda can-



Apples Contain Phosphate and Aluminum

EFFICIENT AND HEALTHFUL

not be changed into gas. Heating soda alone changes it so that a little more than $\frac{1}{4}$ of it becomes carbon dioxid gas, $\frac{1}{10}$ of it is changed to water, and the rest is changed into (normal sodium carbonate) dried washing soda. This washing soda is a strongly alkaline substance frequently left in food if soda is carelessly used *alone* in cooking. But there are other ways of making gas from soda that do not leave this objectionable substance, and at the same time make twice as much gas. One of these is to add an acid, such as vinegar, to the soda. No heating is necessary. Over $\frac{1}{2}$ of the soda is changed to carbon dioxid gas, $\frac{1}{10}$ is changed to water, and the rest helps to form a salt (sodium acetate) that is left. Most acids will do this same thing; so will acid salts; and then there are some salts (normal salts) which, though they are not acids, nevertheless, act like acids. Tartaric acid is a real acid. Calcium Acid Phosphate and Potassium Acid Tartrate (Cream of Tartar) are acid salts, while Sodium Aluminum Sulphate is neither an acid nor a true acid salt, but it acts like an acid in the presence of soda.

All of these are dry, white solids. They will not act as acids on soda unless they are wet, and the sodium aluminum sulphate when moistened scarcely acts till it is warmed, or is allowed to stand for some time. The fact that the sodium aluminum sulphate now used makes a baking powder that acts slowly is not a cause of dissention among baking powder manufactures. Nevertheless, the cause of strife in the baking powder industry must be found in the differences between these four acid-acting substances. We are accordingly interested not only in finding the basis of contention, but in knowing which side is in the right.

As acid-acting materials, these four substances differ in the speed with which they attack the soda. All except sodium aluminum sulphate act on the soda quickly in the cold mix. They are all different in strength.

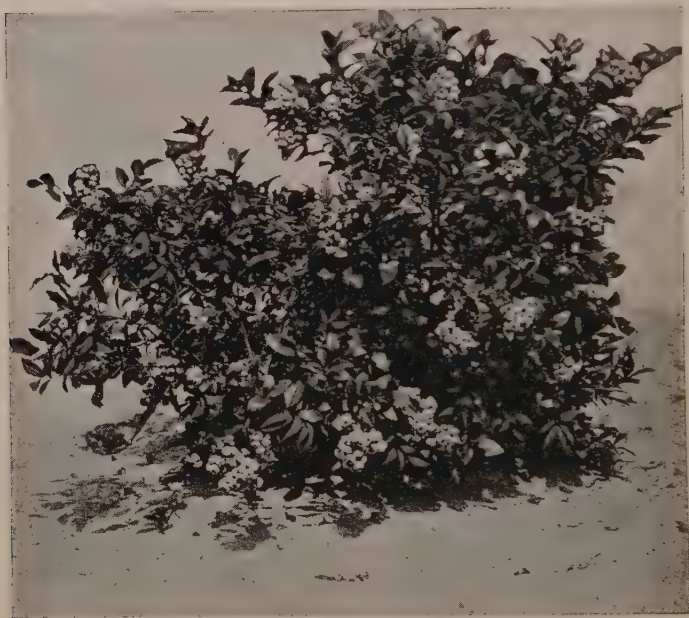
100 lbs. Tartaric Acid liberates all the gas from 112 lbs. Soda.

MODERN BAKING POWDER

100 lbs. Sodium Aluminum Sulphate liberates all the gas from 104 lbs. Soda.

100 lbs. Calcium Acid Phosphate liberates all the gas from 88 lbs. Soda.

100 lbs. Cream of Tartar liberates all the gas from only 44 lbs. Soda.



Blueberries Contain Phosphate and Aluminum
(Courtesy U. S. Department of Agriculture)

Thus it is clearly shown that if these four substances could be bought at the same price, then tartaric acid would be the cheapest to use, S. A. S.* next cheaper, then Calcium Acid Phosphate, and Cream of Tartar would be the most expensive of all. By a little arithmetic, it

* Sodium Aluminum Sulphate—Called S. A. S. in the trade.

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is also easily seen that if tartaric acid were twice as expensive as Cream of Tartar, tartaric acid would still be cheaper than Cream of Tartar for the purpose of freeing gas from soda.

The relative price of these four acid-acting materials is as follows:

Tartaric Acid 38c per pound.

Cream of Tartar $28\frac{1}{4}$ c per pound.

Calcium Acid Phosphate $7\frac{1}{2}$ c per pound.

Sodium Aluminum Sulphate S. A. S. 3c per pound.

With the mention of price one feels trouble coming. "Money is the root of all evil." Where did the trouble start? From the man with the low priced commodity envying the value of the high priced article? No! Oh! No. The makers of the lower cost powders were poor, but they knew the merits of their products were equal to or greater than the high priced ones. They had no fear but they could sell their moderate priced wares at a moderate profit.

On the other hand, the makers of Cream of Tartar powder did not see how they could justify the exorbitantly high price of their powder to the consumer. They decided nevertheless to retain their market of which an equally meritorious product at a much lower price threatened to deprive them. How did they seek to do this? They called Calcium Acid Phosphate and Sodium Aluminum Sulphate "poison" and called upon the people through the press to drive this danger from among them. Of these two substances, Calcium Acid Phosphate and Sodium Aluminum Sulphate, the cheaper was of course the most poisonous according to their hue and cry. The other was nevertheless strongly denounced. Calcium Acid Phosphate was proclaimed by them to be unwholesome until—until—"Until the government stopped them?" No, the government didn't stop them. Those who suffered from these false accusations never took their trouble before a tribunal and the attack continued till it was finally decided more

money could be made by selling Calcium Acid Phosphate baking powder than by continuing the attack. No, they did not wait even that long. They made and sold Phosphate Baking Powder even while they declared Calcium Acid Phosphate and baking powder made from it injurious. It was sold mostly in Canada. When without due notice to the consumer, they started to make a Calcium Acid Phosphate baking powder to sell to the American people, they ceased to declare phosphate injurious.

But the attack against phosphate baking powder was not the main fight. Straight phosphate baking powder did not keep well and this fact placed sales of that product in a very weak position. A lower price did not make much difference if the goods were less efficient.

Baking powders containing S. A. S. did keep well, as did the combination Phosphate S. A. S. powders. They were both strong powders. The speed at which the gas was liberated by the combination powder was better for successful baking than that of the fast acting powders. Here was an enemy with a superior product at a lower price. Fair means could not avail in this unequal fight, and so others were adopted.

The healthfulness of tartrates was in doubt, but they disregarded that and sought to protect themselves and their huge profits with the cry of "poison" pointed at S. A. S., their greatest competitor. There was no basis, in truth, for this accusation, but they knew that the awakening of fear in the mother for the health of her children is not so difficult when a ruthless propaganda is widely spread.

Chapter II

INTERESTING FACTS

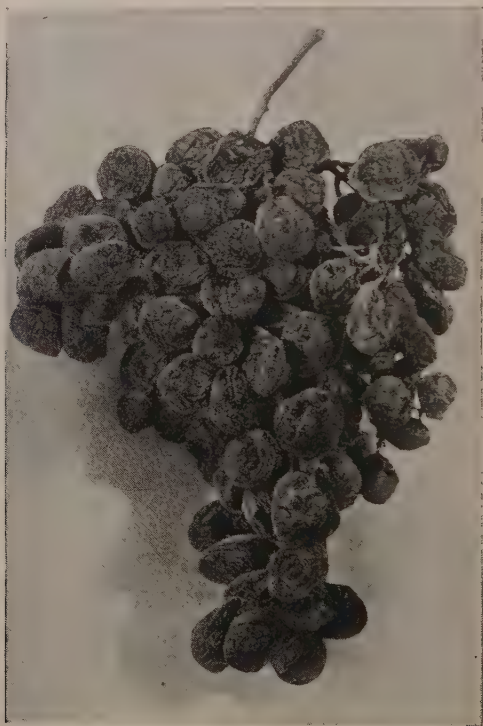
The Royal Baking Powder Company was generally known to be the manufacturer of the Cleveland and Royal brands of cream of tartar baking powder. They bought the Price Baking Powder Company, which operated from Chicago and made the same type of powder. It is true a few wholesale grocers continued to manufacture this type of powder and Schillings did business in the extreme West. Nevertheless, Royal with its three



Oranges Contain Phosphate and Aluminum

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brands and its newspaper and nation wide advertising overshadowed them all. It was this company that started and has continued the attack against baking powders containing S. A. S. Their attacks were mostly



Raisins Contain Phosphate and Aluminum

general in character, never consistently specific. Their cry was S. A. S. is alum, "alum a poison" or "alum is injurious," sometimes making like statements against the baking powder. Now these might seem to be specific charges, but neither Royal nor any of its experts has

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ever produced a single individual who was poisoned or injured by S. A. S. baking powder, or injured by food prepared with it. If it is charged that S. A. S. baking powder is poisonous or deleterious, it would be only fair to state how it poisons and in what respect it is deleterious and what part of the body is injured. If a charge is definite, it can probably be proved or disproved. A definite test of the facts would then settle the question. But the charges were made indefinite and varied, with an article now and then making the injury more definite, but other articles making the injury a different one. Articles were published in the newspapers that charged S. A. S. powders with causing indigestion; they state these powders shrivelled up the stomach; made women nervous, etc. Naturally with this indefinite charge of injury most of the ills of mankind could be attributed by a credulous reader to S. A. S. baking powder.

“*There is nothing so difficult to eradicate from the public mind as a false ‘general impression’, a prejudice of long standing. It dies very hard indeed especially if there is a powerful interest financially interested in keeping it vigorously alive, and this is the case with the old prejudice against what Royal has called “alum” baking powders. That these powders are just as wholesome as any other kind is an established scientific truth, but it is equally true that there still exists in some quarters a prejudice against them which was originated and fostered for the purpose of financial gain by those who knew its falsity. That you may understand how this prejudice was created and by whom, how it is kept alive and why, a brief statement of its history is here given.”

“The best known and most successful brands of straight phosphate and combination phosphate—S. A. S. powders, retail at about 35

* Prejudice vs. Fact, Calumet Baking Powder Company.



Plums Contain Phosphate and Aluminum

cents per pound. The tartaric acid, cream of tartar powders sell generally at 70 cents per pound, or twice as much as their competitors. Here we have the real underlying cause of the misunderstanding and prejudice in the minds of many people.

“If you ask twice as much for an article as your competitor asks for his, you must be able to show that your article is better and more efficient. If you can’t prove such superiority and if you are willing to resort to “knocking,”

you can try to get your price by persuading your customers, in the case of articles of food, that your competitors' low priced article is poisonous and deleterious to health. This is not difficult. Merely establish a doubt in the minds of many people that something to eat is "not good for them" and they are quick to shun it. For years tomatoes were considered unwholesome because "someone" said they were. If you received large sums of money made from exorbitant profits you too could get some chemists and "scientific experts" to express opinions against your competitors' goods, and publish these "opinions" as scientific conclusions.

"That is exactly what has been done and this is why and how it was done:

"In 1888 William Ziegler, an officer and stockholder in the Royal Baking Powder Company, sued Joseph C. Hoagland, also an officer and director in the same company. Both testified and their testimony is preserved in the court records of the Supreme Court of New York.

The following are extracts from that record:

"Mr. Hoagland testified:

"In 1876 our profits were less than they were in previous years; in this year we were face to face with the most serious problem that we ever encountered. The fact was that the sales were that year less than previous years; the fact was that alum baking powder, composed of a substance costing three cents a pound, alum, instead of cream of tartar costing thirty cents per pound, was being substituted for cream of tartar. We were compelled to determine whether we should use that substance or show that substance to be an unwholesome one. We

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found that putting up show cards and circulars had not built up this business to a large extent but had left us with new competition with decreasing sales; we were compelled to determine what we should do with reference to alum baking powder; . . . Then we got the opinions of the Boards of Health and scientific men as to the question of whether alum was wholesome or not. Having obtained that evidence we published the names of all the alum baking powders on the market; During this time we began to advertise with the newspapers more extensively than we had before making these investigations on the subject of the wholesomeness of alum baking powder as a groundwork for our adver-



Grapes Contain Phosphate and Aluminum

tisements; . . . We engaged with the newspapers direct so as to get a reading notice under the regular heading of the papers; I would write these reading notices and they were put in the papers as reading notices; that was one method; there were others; besides that we distributed these phamphlets; we employed all sorts of methods in showing up the use of alum and its wholesomeness. We were showing this alum up as a deleterious substance. . . .

The witness then testified that this advertising was increased from \$17,647.85 in 1877 to \$296,084.71 in 1887 and:

“These advertisements were inserted by this company in over five thousand different papers. These papers were located all over the world, all over this country. . . .

The witness then submitted a financial statement showing how these attacks upon competitors’ powders increased the sales of Royal Baking Powder. This financial statement shows that as a result of this campaign the sales of Royal were increased from \$349,000 in 1876 to \$2,657,000 in 1887, and increased its profits 1300% in that time.

In this suit between Ziegler and Hoagland, both of these officials were claiming the credit for having initiated these attacks against competitors and bragging of the great profits derived as a result of this campaign.

Mr. Ziegler testified:

“I have heard the testimony about what is called the ‘Alum War’. I instituted it upon the part of the company. I employed Dr. Mott personally; it is possible that Mr. Hoagland may have made the money arrangement with him; I also visited other chemists and got certificates; I did all that business connected with the chemical part of the investigation,

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preparing the matter; I originated that matter; Mr. Joseph C. Hoagland bitterly opposed it; he said war on alum would injure the sale of all baking powders; that it would bring all baking powders into disrepute and it was difficult for the public to tell an alum baking powder from a cream of tartar powder.

"We had also as a company been manufacturing alum baking powder which was in the market, not under our brand as "Royal" but another brand. The theory was that our competitors might get hold of some of that, analyze it and show that we also manufactured alum baking powder. . . . When it came to get the



Lilacs Contain Phosphate and Aluminum

certificates from chemists I instructed Mr. Rose to see the principal chemists; I got some myself to give testimonials; I went over and saw Prof. Morton who had given an adverse opinion to get him to give a favorable opinion; I got him to change his mind; he did not deny what he had said before but he gave us something that answered our purpose."

"Thus is it seen that the Royal Baking Powder Company initiated a campaign of propaganda to prejudice the minds of the public against the powders of its competitors which sold at a lower price, and conducted it "vigorously" throughout the land in the newspapers with opinions of chemists which Mr. Ziegler says he "got." Mr. Hoagland admitted that ordinary advertising of their baking powder was not sufficient to meet the competition of the lower priced powders. The "poison gas" campaign was very successful, increasing the sales of Royal from \$349,000 in 1876 to \$2,657,000 in 1887.

"Did the Royal Baking Powder Company really believe that so-called "alum" baking powder was unwholesome? Apparently not, because they were themselves making and selling the same kind of powder, but "under another name." Royal found it could make money both by creating a prejudice against its competitors' powders by calling it "poisonous" and at the same time secretly selling the same kind of powder at a profit.

"The insincerity of the Royal propaganda against competitors, the propaganda that has caused the prejudice against certain brands of baking powder, is again demonstrated by the following astounding facts:

"In 1901 William Ziegler, who controlled the Royal Company, purchased through agents



Roses Contain Phosphate and Aluminum

control of the Southern Manufacturing Company, manufacturing S. A. S. baking powder. This control was held by Ziegler and his estate, which actually meant Royal ownership, until 1914. While thus secretly owning the Southern Company, large dividends were received from the sale of S. A. S. baking powder, but nevertheless, Royal continued to publish its propaganda against "alum" baking powder, claiming it was poisonous. It condemned "alum" baking powder *with one side of the mouth* to fatten its profits at the expense of the public and its competitors, *and with the other side of its mouth* sucked in profits from the

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secret sale of the powder it denounced as poisonous!"

"The above facts appear in the public records of the Federal Trade Commission in the prosecution of the Royal Baking Powder Company by the Commission for conducting these deceptive practices. (See Federal Trade Commission vs. Royal Baking Powder Company, Docket No. 540.)"

"In that proceeding Witness Leigh, of Richmond, Virginia, who was nominal president of the Southern Company during Ziegler's control, testified that at one time when attacks upon the healthfulness of his powder were published by the Royal Company in and around his home city of Richmond, he wrote to the Royal Company and threatened that unless such advertising attacks were stopped he would expose Ziegler as the secret owner of the Southern Manufacturing Company. Royal promptly stopped these attacks in Richmond. (Record of Testimony, F. T. C. vs. Royal Baking Powder Company, page 3983.) Royal knew that if this ownership of the Southern Company were exposed to the public and it were found out that Ziegler was making fat profits from the secret sale of the kind of powder he claimed to be "poisonous," the public would lose all confidence in Royal's campaign of prejudice and refuse to pay exorbitant prices for Royal in order to avoid the "danger" in the lower priced powders."

"Royal's anxiety to get its high price by scaring the public away from competing powders, even though it secretly obtained profits from the sale of the same kind of goods, has also been exposed in other recent cases which have come to the courts. For many years it condemned phosphate baking powders as dele-

terious, describing phosphate as being made from old bones treated with oil of vitriol. It pictured pans of old bones in its advertising to prejudice the public against phosphate. While it was thus condemning phosphate it owned 49% of the capital stock of the Provident Chemical Company of St. Louis, which manufactured and sold phosphate to the very competitors Royal was attacking. (See Findings of Fact. Federal Trade Commission vs. Royal Baking Powder Company, Docket No. 539.) It also secretly owned stock in a company which manufactured Phosphate baking powder. In 1919 it changed its Dr. Price brand from cream of tartar to a phosphate powder, despite its previous insistence that phosphate was repulsive and deleterious."

"Royal appealed from the decision of the Commission in case Docket No. 539 in which the above facts were disclosed. The United States Circuit Court of Appeals, in deciding the appeal against Royal and upholding the Commission's decision against it observed:

"The purpose of the Congress in creating the Federal Trade Commission was aimed at just such dishonest practices and business concerns who resort to dishonest devices of this nature must understand that they cannot add to their revenue or maintain their business standing by methods of competition which the law brands as "unfair" and therefore "unlawful."

See
Royal Baking Powder Company
vs.

Federal Trade Commission
281 Federal Reports, page 753."

Chapter III

WHAT IS SODIUM ALUMINUM SULPHATE?

The Federal Food and Drugs act was enacted in 1906. It forbids the use on the label of a name for a product which is "the distinctive name of another article," or which is such "as to deceive or mislead the purchaser." Many state food laws require that baking powder shall be labeled to show the true names of all the ingredients. The Federal law does not contain this requirement. But so many state laws do, that the large baking powder manufacturer puts the statement of ingredients on every package. When so labeled, every can is admitted under the laws of all the states and there is no confusion in the factory, such as there would be with two or more labels, some legal in one state but not legal in another.

S. A. S. is the only aluminum compound used in baking powder. The manufacturers using this ingredient, name it on the label with other ingredients as Sodium Aluminum Sulphate. That is its true name. It is not the name of any other commercial product. It is commonly called S. A. S. by the trade—each letter being the first in each part of the name. The letters are used as an abbreviation. There is no other name that has ever been applied to sodium aluminum sulphate which is not also used for some other substance, and which is not more commonly used for some other substance.

It is accordingly evident that the use of any other name might easily mislead and deceive the purchaser—that is, any other name might do exactly what the Federal Food and Drugs act and the State Food laws prohibit and were aimed to prohibit.

Nevertheless, competitors of S. A. S. Baking Powder to carry out their self-interested and competitive ends have always made use of another name when referring to sodium aluminum sulphate or to baking powders containing it. Their object in using that name was so to confuse terms as to leave in the consumers' minds the idea

that the use of that type of baking powder was in effect the use of a drug. The name they always use for sodium aluminum sulphate is "alum." Alum is the name of a drug. Most people have seen and used it. But the Federal Food and Drugs act forbids the druggist selling anything under a name in the Pharmacopoeia, except the thing or things therein described by that name. Alum is one of the things named and described in the Pharmacopoeia. Sodium aluminum sulphate is not named or described as alum. In fact, sodium aluminum sulphate is not in the Pharmacopoeia at all. Unlike cream of tartar and tartaric acid, it is not used as a drug and is not sold at the drug store.

There are other Federal laws which prohibit the use of the name alum for the substance S. A. S. They are those governing the interstate shipment of freight. These laws prohibit the interstate shipment of a material under a false classification. Alum is one of the things classified, but sodium aluminum sulphate is not included in that classification. Under other laws alum may be used to denature alcohol, but sodium aluminum sulphate may not be so used.

Accordingly, it is very obvious that when the use of the name alum has been hedged about with legal safeguards, the use of that same name alum for some other product may make the person so using it a criminal before the law.

Of course, those who do not use S. A. S. to denature alcohol, nor ship it as alum, nor sell it as alum are only talking, and talking does not violate these statutes. But they are creating the same confusion in the minds of the public which it is illegal to put in trade practice under laws enacted by Congress. The object of the manufacturers of tartrate powders so misusing the name alum was to so stigmatize S. A. S. baking powders that the mother would fear, or at least hesitate to use such powder in preparing food for her children. Using the name of a common disagreeable drug for S. A. S. would help to instill that fear.

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Recently, they have contended that S.A.S. has been commonly called alum by the manufacturers themselves and by the public at large. In this statement they were more nearly correct, but how far was this condition one of their own making. Laws were passed in two states and rulings made in a few others to this effect: That every can of baking powder should bear on the label a statement, "This baking powder contains the following ingredients and none other....." That the

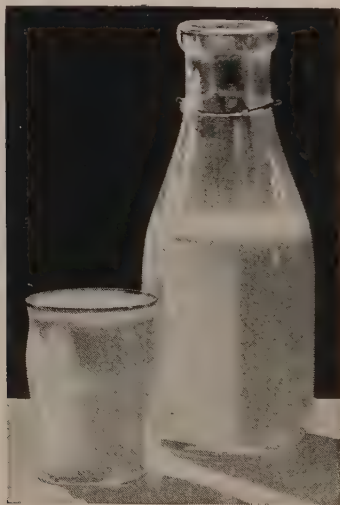


Dandelions Contain Phosphate and Aluminum

common names for the ingredients should be used, *but that any aluminum compound* used in baking powder should be designated by the use of the name "alum." Certainly such laws and rulings misleading the public as to the aluminum compound were not asked for by manufacturers of S. A. S. baking powders, nor did they carry the aim of our general food laws "to avoid deceiving or misleading the consumer." "*Any aluminum compound*" shall be called alum! If two aluminum compounds were used, how would the consumer be advised of that fact?

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The word alum would certainly not give the consumer any true information, unless the substance were in fact the thing she knew as alum. This was very plainly an attempt to make the manufacturer of this type of powder call something "alum" which was not alum. But a desire to do away with discriminatory class legislation which favored one manufacturer by placing hardships on another, and a desire to give the purchaser truth in-



Milk Contains Phosphate and Aluminum

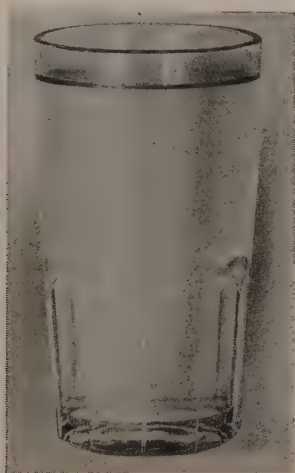
stead of falsehood according to the spirit of the food and drugs act, has gradually resulted in a repeal of these laws and rulings.

Wisconsin is the only state now having such a law and all rulings to a similar effect have disappeared. The legislature of Wisconsin in 1925, passed a bill through both houses to repeal this law in that state, but the bill reached the governor near the end of the session, at the

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same time as the news of Senator La Follette's death. The governor shut himself from the public and finally vetoed the bill without one of its friends having an opportunity to explain to him its real significance. (Even in Wisconsin it is criminal for a druggist to sell you sodium aluminum sulphate when you ask for alum.)

Under such laws, the manufacturer did not have any choice as to what he should call sodium aluminum sulphate. He must call it alum or not do business in those



Drinking Water Contains Phosphate and Aluminum

states. Some manufacturers did stop selling there. Others unwillingly complied to continue doing business. So the manufacturer must use a label which will go anywhere and to do that must label all his goods according to the laws of the state whose law is most drastic. As a result, many of the manufacturers called S. A. S. alum. Today, the large manufacturers of S. A. S. powder call it Sodium Aluminum Sulphate everywhere, except in

MODERN BAKING POWDER

Wisconsin. The few doing business there call it alum on a special label for that state and try to keep their S. A. S. labeled goods out of the state.

The claim that S. A. S. has been called alum must be looked at with the facts in mind (1) that hostile trade interests were parties to making the term alum, a term applied to S. A. S. (2) that the S. A. S. baking powder manufacturers did not want the name alum applied to S. A. S., and (3) that the term alum when used for



Coffee Contains Phosphate and Aluminum

S. A. S. confuses other substances not used in making baking powder with S. A. S., and falsely leaves the idea that S. A. S. is a product of the drug store. That alum is not S. A. S. is clearly set forth in Judge Allison O. Smith's opinion, which was handed down in Pennsylvania deciding a case under law which forbade the use of alum in Food. Judge Smith said:

“*In this case it seems to be conceded on all sides that common alum has been in common use in certain food products. It is fair to assume, therefore, that in using the word ‘alum’ the Legislature had in mind that which was

* See Page 48.

ordinarily known and used as alum. It is admitted by the defense that common or potash alum was formerly used in baking powders, but they claim that it has not been so used for many years. Common alum, it appears from some of the testimony, was recently used to enhance the appearance or value of pickles, and such use may have been aimed at by the Legislature. The testimony in this case is clear that the product used in the baking powder in controversy is a mixture or compound containing sodium sulphate and aluminum sulphate, and is known to the trade as S. A. S. Had this legislation been aimed at this trade, the Act of Assembly ought to have been so worded that the baking powder trade would have notice of the legislative intent. The people affected are entitled to have a hearing before the Legislature as to the injurious or deleterious character of the product intended to be prohibited. The proper tribunal to determine the question of the character and its effect on health is the Legislature. It is very clear from the difference of opinion expressed in the trial of this case that the word 'alum' used in the Act could not have been notice to the baking powder people that their business was being affected by adverse legislation. The common, universal and non-scientific use and acceptance of the word 'alum' would not include the substance known to the baking powder trade as S. A. S."

The commonwealth's witnesses in prosecuting this case had sought to prove that "alum" meant any one of four different substances, potassium alum, ammonium alum, sodium alum or aluminum sulphate. Another quotation from the judge's decision shows how dismally they failed.

"*That practically all of the definitions given for the word 'alum,' singular, in scientific works

* See Page 48.

as well as in dictionaries, speak of potassium aluminum sulphate with the water of crystallization as the common alum of commerce and trade, and when it is intended to refer to other double or single sulphates of aluminum use the qualifying word necessary to express the class



Tea Contains Phosphate and Aluminum

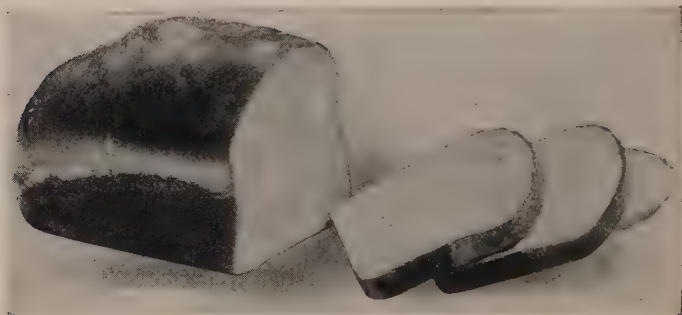
or kind. Professor G. G. Pond, of State College, compiled and used in his testimony, definitions obtained from 169 sources or authorities, general, medical and scientific, and from works in at least three different languages.

“It is clear from a study of this compendium of authority compiled by Professor Pond, that the weight of the written authority is to the effect that the word ‘alum’ has a distinctive meaning in its common acceptation, that is, that it is the ordinary potassium alum. A fair sample of the prevailing written authority on the subject appears in Webster’s New International Dictionary. Under the head of alum, it is defined; ‘1. Sulphate of potassium and aluminum,

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$\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ crystallizing ordinarily in beautiful colorless octahedrons—called specif. potash alum, or potassium alum. It has an astringent taste. Alum has various uses in the arts, and is employed in medicine especially as a styptic and astringent. 2. Chem. Any of a series of double sulphates isomorphous with common alum, in which the potassium may be replaced by sodium, ammonium, etc., and the aluminum by iron, chromium or some other trivalent metal. Ammonium aluminum sulphate, or ammonia alum, very closely resembles potassium alum, and is often sold as alum.'

“It is clear that this authority recognizes that the alum of common parlance is a well known and specific substance, and that this substance is potassium aluminum sulphate in crystalline form. It is also clear from the definition given in some of the authorities that a large number of substances are designated by the general name of alums. There also are double sulphates in which aluminum may be replaced by iron, chromium or manganese, and also in which the potassium may be replaced by some other alkali or ammonium. The general name of alums, therefore, it seems to us, would have a much wider meaning and include a much greater number of substances than was contended for by the expert chemical witnesses of the Commonwealth. As above stated, they limited the word ‘alum’ to the double salts of aluminum produced by potassium, sodium and ammonium and a single aluminum sulphate. We fail to find text book authority for limiting the definition of alums, in the plural, to the four combinations named. If the word ‘alum,’ in the singular, had a wider significance than that of its common use, we fail to understand why it does not include all of the various sub-



Bread Contains Phosphate and Aluminum

stances which have come to be considered in the general class. Such a definition appears in the Century Dictionary under head of alum: 'The general name of a class of double sulphates formed by the union of aluminum, iron, chromium, or manganese sulphate with the sulphate of some other metal, commonly an alkaline metal or ammonium. Common or potash alum has the formula $\text{Al}_2 (\text{SO}_4)_3$ plus K_2SO_4 plus $24 \text{ H}_2\text{O}$.' "

The preceding quotation gives facts which show plainly how the tartrate interests by disregarding singular and plurals, "alum and alums," and by disregarding the use of qualifying words, seek to justify their use of the name alum for S. A. S.

There is a class of substances (more than a hundred in the class) called "alums." One of the class is called "alum," that is potassium aluminum sulphate, crystallized with twenty-four molecules of water in beautiful, colorless, octahedral crystals.

Any one of this class is "an alum." The three expressions "alum" "alums" and "an alum" all meaning something different. What indeed is the good of having singulars and plurals and indefinite articles in the lan-

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guage unless their use does make different meanings. And just such differences are common in everyday life. One uses "salt" in the kitchen and at the table; that is sodium chloride. He purchases other "salts" at the drug store. In other words, there is a class of substances (hundreds of them) known as "salts." One of them and only one of them is commonly thought of and spoken of as "salt" (singular). Any one of them is "a salt" (note the indefinite article). So we have "sugar," "sugars" (and we don't mean "lump," "granulated" or "powdered," which are different degrees of coarseness) and "a sugar" all with similar distinctions. Likewise we are familiar with "alcohol;" we know people used to drink it in beverages; we are also familiar with wood alcohol, which is a different substance and a deadly poison. It is "an alcohol" and is one of the large class of substances called "alcohols." If a substance is "an alcohol," why not call it "alcohol?" If it is "a salt," why not call it "salt?" If it is "an alum," why not call it "alum?" The answer is, do so if you want to confuse different things and muddle other people as to what you mean; do not do so if you want to be understood.



Wheat Contains Phosphate and Aluminum

We are living in a rapidly progressive age. The atom is no longer the smallest particle of matter. We have radio, radio active substances, X-rays, vitamins, all kinds of new electrical and mechanical devices. We give them names, different names, so that we can distinguish and differentiate one from the other. We do not name them so as to confuse them, but to separate them. In the use of chemical terms, we have to invent new ones every day for new substances discovered. Shall we say that it is right to confuse the names of those already well known to us, or shall we continue to use words to convey definite meaning?

The last edition, 1916, of the U. S. Pharmacopoeia, recognizes two things under the name alum, *but requires that they be labeled so one cannot be confused as to what he receives.* This is plain from the reading of the text p. 39.

“Alumen”

Alum.

“It contains not less than 99.5 per cent of $\text{AlNH}_4(\text{SO}_4)_2, 12\text{H}_2\text{O}$ (453.47), or of $\text{AlK}(\text{SO}_4)_2, 12\text{H}_2\text{O}$ (474.53), the label of the container must indicate whether the salt is Ammonium Alum or Potassium Alum.”

Judge Smith shows that he accepts the definition of “alums” as found in the International dictionary. If that defines “alums,” and it does, is S. A. S. (sodium aluminum sulphate) “an alum?”

There is such a thing as soda alum. It is a very rare article but it decomposes in a few days. It is very evident that a material which spoils rapidly could not be used as an ingredient of baking powder, which must keep for a long time. Moreover, soda alum costs more than cream of tartar.

The great difference between S. A. S. and soda alum, common alum and ammonium alum, is readily seen in the

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wide variation between the composition of S. A. S. and the others. A comparison can easily be made from the following table, which at the same time shows the great similarity of the alums themselves.

	S.A.S. $\text{Al}_2(\text{SO}_4)_3$ Na_2SO_4	SODA ALUM $\text{Al}_2(\text{SO}_4)_3$ Na_2SO_4 24 H_2O	POTASSIUM ALUM $\text{Al}_2(\text{SO}_4)_3$ K_2SO_4 24 H_2O	AMMONIUM ALUM $\text{Al}_2(\text{SO}_4)_3$ $(\text{NH}_4)_2\text{SO}_4$ 24 H_2O
M. W.*	484	916	949	906
W. of C.†	None	47.2%	45.5%	47.6%
Al.	11.19%	5.92%	5.71%	5.96%
S.	26.47	13.99	13.52	14.12
O.	52.85	69.80	67.43	70.64
H.	None	5.28	5.10	6.18
Na	9.49	5.01	None	None
K	None	None	8.24	None
(NH_4)	None	None	None	3.97

*Molecular Weight

†Water of Crystallization

The molecular weight of S. A. S. is only half that of soda alum. S. A. S. contains no water. Soda alum contains 47.2%. S. A. S. contains about twice as much aluminum, sulphur and sodium as soda alum and contains less oxygen. Soda alum is a definite known substance and S. A. S. is something very different. If we were to call S. A. S. soda alum, as Royal has sometimes done, what shall we call soda alum itself? Every other name ever advanced for S. A. S. would require giving up an old well-established name to a new substance and renaming the old substance, or else a confusion as to what we do mean when we use the name.

Jim and Henry are your companions. If you call Henry, "Jim" what will you call Jim? Will you call him "Henry?" If you do, what has been gained by the change of names? Such a change of names in the case of S. A. S., alum, or soda alum, is clearly contrary to public interest, though the confusion may be to the advantage of tartrate baking powder companies.

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From the table above, it is easily seen that the three alums there listed have almost the same molecular weight and contain about the same amount of water, aluminum, sulphur, oxygen and hydrogen. They differ from each other in that each contains a different one of the alkalies, sodium, potassium, or ammonium. S. A. S. is materially different in all these respects from any of the alums.

In seeking to justify the use of the name "alum" for S. A. S., some have stated that S. A. S. is very like "burnt alum" in composition, that it differs only in its alkali metal. One contains sodium and the other potassium instead. Is that difference alone not sufficient so that they should not be called the same? Sodium and Potassium salts are very different substances. During the war the American physicians awoke to the fact that the drugs sold them by Germany were generally potassium salts rather than sodium salts. They knew that potassium salts were heart depressants and much more toxic than sodium salts. Accordingly, our own manufacturers were asked to make sodium salts, and these have in many instances permanently replaced those formerly secured from Germany.

Burnt alum is made from alum by heating it at a temperature of 900°F. This decomposes the alum, the water is driven off, and a hydrogen free substance is formed. This is no longer alum. It will not swell up when heated as alum does; it is composed of a fewer number of elements and those that remain are in very different proportions to each other. This is natural. Things that are burnt are generally changed from what they were before. A match is a very useful little article. A "burnt match" is a very different thing. You may strike it as you will it will never ignite as the match did. It is no longer "a match." Neither is "burnt alum" "alum." "Burnt alum" and "Burnt match" are merely words which taken together tell us what the thing originally was and by what process it was changed to its present condition.

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S. A. S. is never an alum in any stage of its manufacture; consequently, it cannot be correctly described as "a burnt alum" or "burnt soda alum."

The purpose of fixing the name "alum" on S. A. S. has been to confuse and mislead the public and to win a trade advantage through this confusion. In this process, they have stretched and distorted the use of the word "alum," they have disregarded modifying words used with it and all the differences in meaning thereby created.

They cannot deny that sodium aluminum sulphate is a truthful name for S. A. S. It is a name that distinguishes it from every other commercial substance. It



Corn Contains Phosphate and Aluminum

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carries a definite, unvarying meaning, which cannot be misunderstood. It is the only aluminum compound used in any baking powder in the United States. It is not alum, and the baking powder containing it is not "an alum baking powder." If "sodium aluminum sulphate baking powder" is too hard to say, use the abbreviation, "S. A. S. baking powder," as is done by the men in the trade. However anyone may theorize, or seek to justify some other name for S. A. S., sodium aluminum sulphate is the only name that tells the truth and does not confuse the substance with some other.

* Pennsylvania Baking Powder Case—Honorable Allison O. Smith, P. J. 46th Judicial District.

Commonwealth vs. Meyer Gross

In the Court of Quarter Sessions of Dauphin County

No. 61, January Sessions 1910

Chapter IV

LAWS PROTECT

In the year 1906, the Food and Drugs Act was passed by Congress. Many states which heretofore had no food laws, proceeded to enact statutes similar to the Federal act. States already having laws amended them to resemble or conform to the Federal law. The Congress and also the legislatures of many states passed laws prohibiting false advertising and prohibiting the printing in the columns of the press without notice to the public what was really advertising matter as reading matter. Manufacturers took notice. Even the manufacturers of tartar baking powder somewhat modified their exaggerations. They were very much more careful about the statements they put in print. In demonstration and sales talks they were not so careful, for here they were safer from detection and many laws that were stringent with reference to printed matter did not apply to the spoken word. But it is hard for a firm doing lots of advertising always to avoid putting the customary conversational business statements in print. So we find the attack against phosphate and S. A. S. powders again appearing in circular letters and pamphlets. In these S. A. S. is declared to be alum, as before, and then alum is declared unwholesome and injurious. If Phosphate and S. A. S. were in fact unwholesome and injurious, there has long before now been ample opportunity to bring the manufacturers of Phosphate and S. A. S. baking powders before the bar of justice for violation of the food law. The Food and Drugs Act declared any article of food adulterated

“Fifth. If it contain any added poisonous or other added deleterious ingredient which may render such article injurious to health.”

The food laws of every state contain similar provisions. The fact that baking powder containing Phosphate and S. A. S. has not been proceeded against under these

M O D E R N B A K I N G P O W D E R

provisions of the law is a true sign that such baking powder does not contain a poisonous or deleterious ingredient, or one that may render such article injurious to health.

The food officials of the 48 states, and the many state's attorneys in each of these states, are bound under their oath of office to proceed against violations of these laws.



Rice Contains Phosphate and Aluminum

Likewise all the Federal district attorneys throughout the United States and the U. S. Department of Agriculture through its representatives in the Bureau of Chemistry are similarly obligated to protect the public health and well being. In order to do this fully, the Bureau of Chemistry established laboratories in large cities

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throughout the country, (Boston, New York, Philadelphia, Cincinnati, Chicago, Kansas City, Denver, San Francisco, Seattle, Galveston, New Orleans, etc.) and sent out inspectors from these points to discover adulterations and bring prosecutions to remove them from sale and punish the vendors. But with all this activity and with a hostile company making charges against the Phosphate and S. A. S. powders no prosecution on the ground that it was unwholesome or injurious has ever been considered since the passage of the Food and Drugs Act or since the exposure of bribery and corruption in Missouri.

Three-fourths of the people of the United States were using combination baking powder and there never had been any indication that any consumer was being injured. But even though no one was injured, the government felt that while anyone made charges it must determine the facts by a scientific investigation. Accordingly it submitted the question of the healthfulness of aluminum compounds to the Referee Board for a thorough investigation. This Board was composed of men of the highest reputation in the scientific branches in which knowledge was needed for such an investigation. They were men of integrity seeking the facts and absolutely disinterested as to whether these facts were favorable or unfavorable to the use of aluminum compounds in food. These men were selected by President Roosevelt himself after consultation with many college presidents. And this Board was then, at the direction of the President, appointed by the U. S. Secretary of Agriculture. This board was appointed primarily to investigate Saccharin, Benzoic Acid, Salicylic Acid, and Sulphur Dioxid, the question of aluminum compounds was submitted to them later. The men appointed were: Ira Remsen, President of Johns Hopkins University, Chairman; Russell H. Chittenden, Professor of Physiological Chemistry in Yale University and Director of the Sheffield Scientific School; John H. Long, Professor of Chemistry in the Northwestern University Medical School; Alonzo E. Taylor, Benjamin Rush, Professor of

Physiological Chemistry in the University of Pennsylvania and Theobald Smith, Professor of Comparative Pathology in Harvard University.

The questions submitted to the board were as follows:

- *“1. Do Aluminum compounds, when used in foods, affect the value of such foods or render them injurious to health?
2. Does a food to which aluminum compounds have been added contain any added poisonous or other added deleterious ingredient which may render the said food injurious to health? (a) In large quantities? (b) In small quantities?
3. If aluminum compounds be mixed or packed with a food, is the quality or strength of said food thereby reduced, lowered, or injuriously affected? (a) In large quantities? (b) In small quantities?”

“In order to base their report upon first-hand knowledge, the board instituted three sets of experiments, each independent of the others. One set of experiments was conducted by Dr. Russell H. Chittenden, of the Sheffield Scientific School, Yale University, New Haven; another by Dr. Alonzo E. Taylor, of the Medical School of the University of Pennsylvania, Philadelphia; and the third by Dr. John H. Long, of the Northwestern University Medical School, Chicago. In each case tests were made on healthy young men by including aluminum in some form in their food. The food was all carefully measured and weighed and the amounts of its principal ingredients were determined by analysis. The excretions of the men's bodies (both urine and feces) were carefully collected,

* Bulletin of the U. S. Department of Agriculture, No. 103.

¹ See page 56.

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examined, and analyzed. Daily records of body weight, temperature, respiration, and pulse were kept for each man, and notes were made of any unusual symptoms. Any disturbance in health or physiological processes was thus detected.

“Each experiment included three periods, in the first and last of which no aluminum was administered. During the middle period aluminum compounds were administered, the ‘dose’ increasing as the experiment progressed. In this way the effect of large quantities was com-



Oats Contain Phosphate and Aluminum

pared with that of small quantities. In Dr. Chittenden's and Dr. Taylor's experiments some of the men who served as 'control' subjects received no aluminum at any time, so that any disturbances due to other causes might be checked up."

Each of these three investigators, with all the facilities of the great universities they represented at their command, together with their many assistants especially employed for this work, conducted feeding experiments on men for a period of approximately six months. After the work was finished they drew up a unanimous report signed by all the members. (See Bulletin 103, U. S. Department of Agriculture.) In their report the board first define their understanding of the terms "small quantity" and "large quantity," as applied to baking powders, as follows:

"By the term 'small quantity' we understand such an amount as may be ingested in the normal use of biscuits, pastry, or other articles leavened with baking powder, as these foods are practically used in the ordinary American family. This amount will not average more than 25 to 75 milligrams² (0.39 to 1.16 grains) of aluminum daily for the days of consumption of such articles.

"By the term 'large quantity' we understand such an amount of aluminum as would be ingested only under very unusual conditions, as for example, where the flour consumption is mainly in the form of biscuits or other articles leavened with aluminum baking powders. This amount may reach 150 to 200 milligrams¹ (2.31 to 3.09 grains) of aluminum per day. A person subsisting mainly on baking-powder biscuits, as may happen in camp life, might ingest an amount in excess of 200 milligrams per day. With this possibility in mind, we have also

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studied the effects of amounts up to and exceeding 1,000 milligrams² (15.4 grains) of aluminum per day.

“With this understanding of the terms, the board give the following answers to the questions submitted to them:

“Aluminum compounds when used in the form of baking powders in foods have not been found to affect injuriously the nutritive value of such foods.

“Aluminum compounds when added to foods in the form of baking powders, in small quantities, have not been found to contribute any poisonous or other deleterious effect which may render the said food injurious to health. The same holds true for the amount of aluminum which may be included in the ordinary consumption of aluminum baking powders fur-



Sugar Cane Contains Phosphate and Aluminum

MODERN BAKING POWDER

nishing up to 150 milligrams (2.31 grains) of aluminum daily.

“When aluminum compounds are mixed or packed with a food, the quality or strength of said food has not been found to be thereby reduced, lowered, or injuriously affected.”

In short, the board conclude that S. A. S. baking powders are no more harmful than any other baking powders.

“We must not, however, be oblivious of the fact,” says Dr. Taylor, who conducted part of these investigations, “That a saline cathartic residue results from the reaction of every form of known baking powder now commonly employed. The use of cream of tartar or tartaric acid baking powder leaves in the alimentary tract a residue of tartrates which exhibit the action of a saline cathartic and of diuresis (excessive excretion of urine) as well. The so-called phosphate baking powder leaves as a residue of reaction sodium phosphate, again a saline cathartic. And aluminum baking powder leaves as a residue of reaction sodium sulphate, a saline cathartic. Apparently therefore, at present at least, the use of baking powder is associated with the introduction into the alimentary tract of a certain amount of saline cathartic, the salt differing with the use of the particular type of baking powder.”



Sweet Potatoes Contain Phosphate and Aluminum

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It is accordingly to be observed that it is "only under very unusual conditions, as for example, where the flour consumption is *mainly* in the form of biscuits, or other articles leavened with aluminum baking powders" that aluminum baking powders *may* produce a slight laxative effect, and that in this respect a like effect is produced by "every form of known baking powder now employed." But the Referee Board did not compare the relative amounts of cathartic residues left from the different types of powder. Cream of Tartar powders leave over twice as much in the food as do S. A. S. or Phosphate powders when the same amount of baking powder is used. Cream of Tartar baking powder manufacturers recommend the use of two teaspoonfuls of their powder to a quart of flour. S. A. S. baking powder manufacturers recommend the use of only one teaspoonful. So those following directions will have not twice as much, but four times as much rochelle salts in food prepared with cream of tartar powder as they will have of sodium sulphate in food prepared with S. A. S. baking powders. It would appear certain from these facts that those wishing to avoid any cathartic effect from the use of exceptionally large amounts of baking powder food would choose the S. A. S. or S. A. S. Phosphate type of baking powder.

There has been much hostile comment directed against both sides in this baking powder war as if both sides were intent on keeping up the fight. Such an assumption is absolutely contrary to the facts. Only one side has been interested in keeping up the fight. The other side has acted only on the defensive. The cream of tartar interests have attacked S. A. S., but attacks against cream of tartar, though much more warranted, have scarcely reached the public ear. That such an attack could be made is clearly shown in the statement of Dr. Taylor in Bulletin 103, U. S. Department of Agriculture: "The use of cream of tartar or tartaric acid baking powder leaves in the alimentary tract a residue of tartrates which exhibit the action of a saline cathartic *and of diuresis (excessive excretion of urine) as well.*"

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(The italics are ours.) That the S. A. S. baking powder people have not viciously attacked the use of cream of tartar powders because of this diuretic effect especially when the medical literature contains so much to show the injurious effect of tartrates on the kidney, should certainly exonerate them from any charge of keeping this conflict alive.

The conclusions of the Referee Board on the use of aluminum compounds in food showing that S. A. S. baking powders were as healthful as any other became a guiding fact not only for the Bureau of Chemistry in its enforcement of the Food law, but was so accepted by every State Food Commissioner. It had previously been accepted by seventy-five per cent of the people of the United States, as evidenced by their actual purchase and use of this type of baking powder. They had not made scientific tests to satisfy themselves, but they had made the practical test of eating food prepared with S. A. S. powder, day after day, year in and year out. As a result of this practical feeding test by over 75,000,000 people, there has not been discovered one single case of injury of any kind to any human being. The work of the Referee Board in its scientific investigations for three approximately six-month periods on young men brought no unlooked for conclusions, but agreed with the practical experience of consumers from the time S. A. S. powders were first marketed in 1889 down to the present day. The consumer expected the verdict of honest scientists to agree with his practical experience of two score years. It did: S. A. S. baking powders are as healthful as any other baking powders.

The laws passed by Congress and the States are designed to protect the health of the consumer and prohibit the transportation or sale of any food that *may be* poisonous or deleterious to health. These laws are being enforced by able, industrious officials, who are disinterested as to whom the penalties of the law may reach. The consumer can safely trust these men rather than those, who in the interest of their own greed for gain, condemn the products of their competitors.

Chapter V

PHOSPHATES

Phosphates are present in natural waters, soils, rock and in the bones and tissues of man and animals. They are essential to animal and plant life. They are present in most of the foods consumed by man. They have been favorites as additions to beverages and have been added to fruit juices not rich in pectin to cause them to jell.

For the housewife, the use of phosphates in baking powder has been practically confined to a single product, Calcium Acid Phosphate, commonly referred to in this connection as such or as acid phosphate or even phosphate. Two attempts to vend a baking powder made with sodium acid phosphate have been made, but both failed.

Calcium Acid Phosphate is prepared in different ways from two different materials, bone and phosphate rock. Large deposits are found in Tennessee and Florida. These two materials are of much the same composition and contain as the principal phosphate material, tricalcium phosphate. The bone or rock is treated with acid in such a manner as to form phosphoric acid. This acid is then purified and finally combined with dicalcium phosphate to form the finished product.

By another process, phosphate rock is subjected to an electrical process whereby the phosphoric acid is distilled over, thereafter the two processes are the same.

The finished product is a dry white substance that acts as an acid in solution with soda and quickly releases the gas therefrom. It is the same identical substance whether produced from rock or bone. Some manufacturers use powdered phosphate and powdered soda and others use a granular phosphate with granular soda. The granular phosphate and soda are more expensive than the powdered. The granular materials have fewer points of contact than the powdered materials and consequently by the use of granular materials the phosphate

and soda are kept better separated, resulting in a powder with less danger of deterioration.

The phosphate in a Combination Powder gives the initial rise in the cold mix as soon as the dough is made. All the gas thus produced is not evident to the eye. Some is dissolved in the water and gives no increased volume to the dough until warmed in the oven, while the rest leavens even in the cold mix. This first action results in an increased volume which exposes a greater surface in the oven for the quick absorption of heat and a consequent quicker action than would otherwise obtain from the S. A. S. in completing the leavening work.

Baking powder manufacturers, who have attacked powders containing phosphate, now admit that their information was at fault and are openly praising phosphate baking powder, which they now manufacture and sell themselves.

A few faddists, for a time, took the position that phosphates must be in organic combination, such as is found in animal or plant life to be available as food for man and that mineral phosphates were not in an available form. This idea has been exploded and medical science has proven that mineral phosphates and mineral salts of iron, iodine, etc., were just as available as the compounds found in vegetables and animals.

It has always been difficult to take seriously any of these attacks by interested trade people. It was especially difficult in the case of phosphates in light of the almost universal knowledge of its presence in the blood, tissues and bones of both man and animals.

Whatever prejudice may have been temporarily roused against phosphates in baking powder have been dispelled by the scientific fact that mineral phosphates are easily digestible by man as the phosphates naturally occurring as a part of our vegetables and meats. Phosphate in baking powder takes the place in our food of phosphate removed from wheat in the milling process to produce white flour. The modern combination baking powder containing a large proportion of phosphate, furnishes phosphate as a food, as well as furnishing a dependable leavener, resistant against ordinary causes of deterioration.

Chapter VI

WHITE OF EGG

White of egg is used as an ingredient in almost every type of baking powder. It was used in one of the popular Cream of Tartar powders until its makers were absorbed through consolidation with another company. The consolidation discontinued the use of white of egg and that brand of cream of tartar powder has practically vanished from the market. Few, if any of the mixed Tartaric Acid—Cream of Tartar powders now on the market do contain egg. Some of the straight S. A. S. and some of the straight phosphate powders contain white of egg. Practically all of the combination powders which contain a goodly proportion of phosphate do contain it.

White of egg is never added to baking powder in large quantities. It is not intended to take the place of eggs in the baking. The amount used is stated by some manufacturers on their labels as 15/100 of one per cent. The purpose of its use is often shown on the label: "The dried white of egg furnishes a means of estimating the available gas."

The Federal government has adopted the following standard for baking powder as shown on page 22, of Circular 136, of the U. S. Dept. of Agriculture, entitled: "Standards of Purity for Food Products."

"Baking powder is the leavening agent produced by the mixing of an acid-reacting material and sodium bicarbonate, with or without starch or flour.

"It yields not less than twelve per cent (12%) of available carbon dioxide.

"The acid-reacting materials in baking powder are: (1) Tartaric Acid, or its acid salts, (2) Acid salts of phosphoric acid, (3) compounds of aluminum, or (4) any combina-

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tion in substantial proportions of the foregoing."

The U. S. Government has, accordingly, fixed a minimum of 12% available gas as a strength which must be equalled or surpassed by baking powders entering interstate commerce. Manufacturers comply with this requirement and, in fact, nearly every baking powder marketed is manufactured so as to produce over 12% when fresh.

Nevertheless, it must not be forgotten that baking powder is a perishable product. "Keep your powder dry" applies to baking powder just as much as it does to gun powder. Baking powder sets free its gas only when moistened, but it is equally true that it always sets gas free when it is moistened. There is moisture everywhere. Not only rain, leaky freight car and uncovered delivery wagons, but even the dampness in the air especially with varying temperatures threatens the deterioration of baking powder.

Baking powder is generally sold in tin cans, tightly sealed, in order to exclude moisture as much as possible. But these cans are of the slip cover type, which, even when sealed with a label, still permits the access of some air through the paper. There is air in the can, not only at the top, but between the particles of the powder.



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This air expands when the can becomes warm, due to higher afternoon temperatures and a portion of the air is driven from the can. During the night, the can and its contents get cooler, the air inside contracts forming a partial vacuum and draws air into the can. Thus a can of baking powder may be said to breathe once every twenty-four hours.

The air drawn into the can carries with it the same per cent of moisture that is in the surrounding atmosphere. This moisture gets in contact with the powder. Ultimately enough is absorbed to deteriorate the powder. Such deterioration takes place very slowly in the elevated Western section of our country because the atmosphere is dry and, in spite of repeated "breathing" but little moisture is taken into the can. When the atmosphere is moist, as is the case near the sea, the deterioration is more rapid.

It is under such conditions that starch, especially the re-dried starch, becomes active. It absorbs the moisture with avidity and thus keeps it away from the soda and acid ingredients. When the starch has absorbed moisture so that it contains about 13%, it ceases to protect and deterioration will proceed more rapidly.

For years, one western manufacturer of Cream of Tartar powder ignored the great value of starch to thus absorb moisture and thereby add to the keeping qualities of his goods. His powder was a mixture of but two ingredients, soda and cream of tartar. He claimed that: "Starch diluted baking powder, just as water dilutes milk" and published such statements in connection with charts prepared to show the amounts of starch used by different manufacturers. Evidently this broadcast of his own views resulted in a flood of facts in return for he very shortly adopted the use of starch in his own powder.

Starch not only preserves the powder by absorbing moisture, but also preserves it by keeping the particles

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of the acid ingredients separated from the particles of soda.

The white of egg plays practically no part in protecting the powder, but it does play an important part in protecting the consumer, the grocers and the manufacturer. It protects the manufacturer's and the dealer's reputation for dependableness. It protects the consumer against receiving deteriorated powder and against the loss of the other more expensive ingredients which would be spoiled if baking was attempted with a weak powder. However, such protection is not afforded unless there is vigilance on the part of the distributor in watching stocks and checking up on the condition of the goods going out to users. This safeguard is made possible by the presence of dried white of egg as an ingredient.

The dried white of egg dissolves almost instantly on the addition of water to the powder, giving a viscous, gas-retaining power to the solution. As each little bubble is set free from the powder, it is enclosed by this solution of white of egg in water. The accumulating bubbles rise in the container and the freshness of the powder may be determined accordingly.

One manufacturer, the Calumet Baking Powder Company, of Chicago, not only continually tests its goods on the retailers' shelves through their salesmen, but even prints such directions for the housewife, as follows:

HOW TO MAKE THE TEST

First, take an ordinary drinking glass holding one-half pint, or in other words, the quantity that is usually known in the household as "one cup full." All that is needed is this empty glass, which must be dry, an ordinary teaspoon and a little water of the ordinary room temperature (not ice water nor hot water). Place 2 level teaspoonfuls of the powder in the

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dry glass, to which add the same quantity (2 teaspoonfuls) of water, quickly; stir rapidly for a moment; (while counting 5) just long enough to thoroughly moisten the powder; remove the spoon and watch the mixture rise. Note the action of the powder. CALUMET rises slowly and evenly, requiring 2 minutes to show the full strength. If the powder is of



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full strength and you have proceeded properly, the gas released will form bubbles sufficient to half fill the glass.

Such a test cannot be made with a powder that does not contain dried white of egg, because the bubbles of gas break rapidly, permitting the gas to escape.

This is the only effective test of the condition of baking powder that has been devised, other than those of the chemical laboratory. A spoon, a glass and some water are the only requisites. The test can be made anywhere, in the store or in the kitchen.

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This manufacturer instructs its salesmen to make these tests and replace any deteriorated powder found on the grocer's shelf with fresh goods, free of charge. It is because this test is so effective in the salesman's hands that it can guarantee full satisfaction to the housewife.

Doubtless, the conscientious application of this test by this firm and other manufacturers of Combination Baking Powder is responsible for the wide popularity of this type of powder.

Chapter VII

MODERN BAKING POWDER

At the beginning of the Baking Powder Era simple types of baking powder were the only ones on the market. Each baking powder contained only a single acid ingredient. But as baking powder was put to every day use in the home, after being subjected to the delays and atmospheric changes incident to transportation and merchandising, certain defects in these simple types became evident. Manufacturers realized that a successful business depended on removing these defects.

The powders did not always reach the consumer in perfect condition. The powders were sometimes deteriorated. The chemical action, which set free the gas, had taken place prematurely in the can and, hence, could not take place in the cake batter as intended.

To overcome this difficulty, some powders were actually sold in two separate packages, one containing the soda and the other containing the acid ingredient. This method required a measuring and mixing of these by the housewife as they were used. It was not popular. Other manufacturers used glass bottles in a vain endeavor to preserve the product. Others sought by the selection of acid ingredients and by more refined methods for their manufacture to overcome the difficulty.

In this last method of reaching a solution of the difficulty other defects in the original powders were also considered. Bakers complained that one baking powder worked too fast and that another worked too slow. By this, they meant that on adding the water or milk to make the batter, some immediately evolved practically all the gas the powder produced, while others scarcely developed any gas in the cold mix and released it only while being heated in the oven.

The straight phosphate and straight cream of tartar powders were the ones which acted too quickly and the

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straight S. A. S. powder was the one that acted so slowly.

It was found that doughs made with the fast acting powders must be placed in the oven immediately after mixing or that some of the gas would escape and the good results would not be obtained. It was also noticed that the best results with such powders were obtained in a quick oven, since all of the gas being free it was likely to escape from the dough if a low oven were used.

On the other hand, the slow acting powder produced the best and surest results in a slow oven. This lower temperature allowed more time for the heat to penetrate the dough and cause the leavening gas to be liberated before a crust was formed that would prevent the uniform expansion of the cake.

All these difficulties were finally solved by the production of a powder containing both Phosphate and S. A. S. Powders of this type give their best results in a medium oven which is the easiest to maintain without the dangers of either burnt or uncooked food that are attendant to the use of extremes of oven temperature. This type of powder is the modern baking powder of today. It has achieved such popularity that it is not only to be found on every grocer's shelf, but is sold and consumed in larger quantities than all of the other kinds combined. It is popularly called a Combination Powder, being thus referred to because both a fast-acting acid ingredient and a slow-acting one are combined in substantial proportions in the same powder.

It is also known as a Phosphate S. A. S. Powder. The best brands contain at least four times as much by weight of phosphate (PO_4), as of aluminum (Al). They produce a substantial portion of gas when stirred in a glass with an equal volume of water. They are not to be confused with those which contain only enough added phosphate to legalize including it among the listed

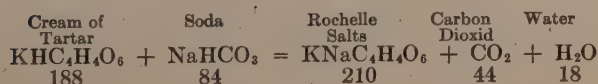
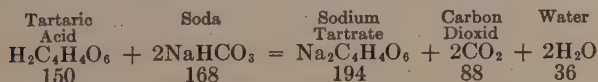
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phosphate ingredients of the powder, and which scarcely react in the cold when mixed with milk or water.

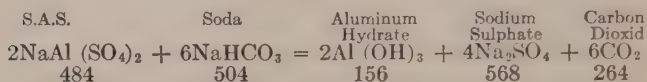
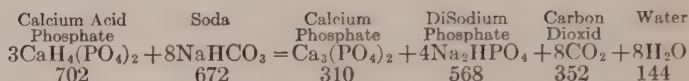
There have also been changes in the tartar type of baking powders, though the reasons for them do not appear to be for the improvement either of the keeping qualities or of the speed of action of the powder. A straight cream of tartar powder acts very quickly, as can be seen by stirring a spoonful in a glass with an equal amount of water. The prominent brands of cream of tartar baking powder have, nevertheless, been changed by reducing the amount of cream of tartar and substituting tartaric acid, thus making a still faster acting powder. This substitution has gone so far that now about one half of the cream of tartar originally in these powders has been so replaced. These powders are not the true cream of tartar powders of Mother's day, but are in reality Tartaric Acid—Cream of Tartar Powders. What, if any, value to the consumer this change has brought about has not been made public, but it is well known that it has saved the manufacturer of that type of powder a considerable amount of money.

The consumption of this tartar type of powder is now only about one-eighth of the total in this country. About one-fifth of the sales is divided between the straight phosphate and the straight S. A. S. types while the modern Phosphate—S. A. S. type receives the rest, overtopping the sales of all the others combined.

A chemical change takes place when a baking powder releases its gas. The starch and dried white of egg in the powder take no part in this chemical change. As a result of the chemical change, the ingredients other than the starch and egg are changed into other substances.



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The cream of tartar and soda are changed to Rochelle Salts, carbon dioxid and water.

The Tartaric Acid and Soda are changed to Sodium tartrate, carbon dioxid and water.

Calcium Acid Phosphate and Soda become Calcium Phosphate, Di-Sodium Phosphate, carbon dioxid and water.

S. A. S. and Soda become Aluminum Hydrate, Sodium Sulphate and Carbon Dioxid.

The combination powder leaves aluminum phosphate as one of the residues instead of aluminum hydrate.

When the Baking Powder is properly compounded, none of the S. A. S. soda or calcium acid phosphate, or cream of tartar or tartaric acid remains in the finished food.

It is incorrect and misleading to refer to a combination powder as an S. A. S. Powder, just as it is incorrect to call a mixed Tartaric Acid, Cream of Tartar powder, a cream of tartar powder. The combination powder contains phosphate which is not contained in the S. A. S. Powder; it has a different speed of action, bakes best in a medium oven and leaves different residues in the food.

The best brands of combination baking powder contain a small amount of dried white of egg and the use of granular phosphate and granular soda adds materiality to their keeping qualities.

It is interesting to notice here that the selection of these two acid-acting ingredients to make a combination powder is a selection of two things both of which are commonly found in our everyday foods, phosphate and aluminum. The illustrations in this book show some of the common foods containing them, but by no means includes them all.

Chapter VIII

ABUNDANCE OF ALUMINUM

While it is not strange that scientific experimental conclusions should agree with the results of long-time, practical experience, it is remarkable that so little is generally known about the comparatively large amount of aluminum compounds in natural foods and their abundance in the earth. No attention seems to have been given to the universal presence of aluminum compounds. They are not rare; they are common. They are not found like gold in isolated deposits; they are spread everywhere. The ruby, sapphire, turquoise, topaz, and garnet are compounds of aluminum, but they are mere particles as compared to the widespread diffusion of other aluminum compounds such as feldspars, micas and clays, occurring in rock and soils everywhere in all parts of the world. One is apt to think of iron as the commonest metal, but there is nearly twice as much aluminum in the earth's crust as there is iron. It is estimated that four elements compose over 85% of our earth's crust:*

Oxygen	47.33%	
Silicon	27.74%	
Aluminum	7.85%	
Iron	4.50%	
	87.42	

Aluminum is the most abundant metal, and most widely distributed in nature. Like iron, it is always found combined with other elements and not as a free metal. Most of these compounds are not soluble in the soil waters, but very small portions of even the most insoluble substances are all the time being acted on by the acids in the earth and changed into other substances that do dissolve in the waters.

* Inorganic & Theoretical Chemistry—J. W. Mellor.

Plants take up traces of soluble aluminum compounds from the soil into their sap and hence these compounds are found in the roots, trunk and branches, less in the husks and seeds and least of all in the leaves. Aluminum is found not only in trees but in mosses, grasses, bushes and every form of vegetable life, the wild plant of the meadow and the forest, and the cultivated vegetables of the garden as well as the cereals of the farm. Every animal and every man that eats roots, stems, leaves, fruit or seeds is therewith taking into the stomach aluminum compounds. We must not suppose that this is something new or something unexpected. Plants have grown in the same manner as today ever since the world began. Their roots have woven into the crevices of the aluminous earth while their stems and leaves have extended upward in the air. The roots drank in surrounding waters with their soluble mineral salts and the sap distributed these to various parts of the plant. They have done this in the ages of the past just as they are doing it today. The aluminum compounds in plants we may expect will be much more soluble than those in the soil. In fact, the few investigations that have been made confirm this view. Plants have been the exclusive food not only of sheep, goats and cattle, but of all other herbivorous animals. They have formed a large part of the food of man and other omnivorous animals. The plant has taken aluminum from the soil and the higher animals and man have eaten the aluminum compounds that are in the plant. So aluminum compounds in food are not a new addition, but have always since the beginning of the world formed a part of the diet of man.

Are there aluminum compounds in the tissues of man and animals? There probably are, but just as there is less aluminum in the plants than there is in the soil, so there is less in animals living on plants than there is in the plant. The plant does not take into itself all the aluminous substances with which its roots come in contact, but only takes what it needs and within

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the ordinary variations of concentration found in nature, the amount absorbed does not seem to depend on concentration. Whereas the plant has its roots in earth containing over 7% of aluminum, the animal living on plants alone eats food containing only a fraction of a per cent. Just as the plant rejected a large part of the 7% aluminum possibly available for its food, so these animals absorb but a small part of the fraction of a per cent of aluminum available to them in their plant food. Animal flesh contains less aluminum than vege-



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table matter contains. It would be expected that carnivorous animals would absorb less aluminum than omnivorous animals because their food contains less, but differences of kind and abode may even here exhibit as great differences as appear between different plants. We know that man, and the animals used as food by him, do absorb aluminum in small amounts, amounts that are so small that present methods make it impossible to always state them with exactness. Aluminum compounds found in cows' milk, in hens' eggs, in mothers' milk, and, in various cases, in body tissues, indicate their presence is minute but normal body constituents of animals and man. The amounts of aluminum found in some of the commoner foods is shown in the following tables:*

* From Aluminum Compounds in Food by E. E. Smith.

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I. Aluminum in Food

Source of Tables?

Vegetable Kingdom

a. Cereals and Vegetables

	Total Ash	% Al_2O_3 in Ash	% Al_2O_3 in Whole Product
Barley, air dry.....	1.09	0.140	
Bean, red, air dry.....	1.09	0.096	
Bean, soy, air dry.....		0.053	
Beets, root, dry.....	13.4	0.28	
	11.27	0.25	
Leaves ".....	20.86	0.12	
	15.57	1.99	
Buckwheat, air dry.....	1.72	0.113	
Coffee beans.....		Trace—2.78	
Corn, kernel.....		Trace	
Oats, dry.....	3.06	0.07	
Peas, dry.....	2.10	0.17	
Peppers, red.....	6.76	Trace	
Potato (sweet).....	1.51	Trace	
Rice (hill) air dry.....	0.87	0.161	
(paddy) air dry.....	0.56	0.189	
Rye, dry.....	1.90	0.50	
Tea leaves.....		0.81	—2.226
Wheat, 22 samples.....			0.001—0.070*
" air dry.....	2.62	0.106	
" winter.....	1.62	0.11	
" grown on sandy soil		None	
Yeast, dry.....	9.73	Trace	

*Egyptian, probably contaminated with clay.

b. Cereal and Vegetable Products

	Al_2O_3 in Whole Product
Bread, crumb, No. 2 Crown flour.....	0.005
" coarse flour.....	0.004
" as purchased, 32 samples, crumb	0.001—0.003
" various flour, 15 samples	0.001—0.005

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Flour	Total Ash	% Al_2O_3 in Ash	% Al_2O_3 in Whole Product
No. 2, Crown.....			0.007 -.010
Various, 33 samples.....	0.26-1.44		.0004-.0085
{ Wheat (original English			
on chalk soil).....	1.72		0.005
{ Bran (18.5% of wheat)...	5.64		0.007
{ Sharps (8.5% of wheat)..	2.00		0.007
{ One Crown (26% wheat)..	0.50		0.003
{ Four Crown (45% wheat)..	0.368		0.003
Various, 12 samples.....			0.004-.025
Various, 6 samples.....			0.023-.080
{ Wheat, winter.....	1.62	0.11	
{ Bran.....	5.25	0.07	
{ Ship stuff.....	3.08	0.18	
{ Dust room.....	2.50	0.04	
{ Low grade.....	0.70	0.12	
{ Straight.....	0.40	0.15	
{ Patent.....	0.31	0.41	
Sugar, cane.....		0.65	

c. Fruit and Fruit Products

	Total Ash	% Al_2O_3 in Ash	% Al_2O_3 in Whole Product
Almond		0.138	
Apple, ripe.....	0.30	0.80	
Blueberries, dry.....			0.005
Cherry.....	0.516-0.739	0.80-2.55	
Chestnuts, dry flesh.....	3.02	0.09	
Currants, red and white, juice...			Trace
Grape, red.....			0.00027
Grape juice, 18 various	0.252-0.395	0.021-1.60	0.004
Orange Peel.....	1.21	0.069	
Plum, fresh.....	0.407		0.003
Strawberry, juice.....			Trace
Vinegar, cider.....		0.158-1.654	
Wine, 14 various	0.030-0.593	0.377-3.956	
7 various			0.0 -0.0036
7 various			0.0004-0.0072

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II. Animal Kingdom

	Total Ash	% Al_2O_3 in Ash	% Al_2O_3 in Whole Product
Beef, fresh.....	2.2	Trace	
Egg albumen.....	2.3	6.29	
Honey.....			0.0046 Al_2O_3
Veal, Breast.....	3.1	Trace	

* Julius Stoklasa has found that not only do aluminum compounds form a part of the coloring matter of flowers, but that in the animal world birds and insects contained more aluminum if the colors were blue, violet, red and blue-green, than was the case with other colors.

These tables give only a few of the more common foods in which aluminum is found.

III. Aluminum in Natural Waters

a. Lakes

	Parts per 100,000 Al_2O_3
Borax, Calif.....	.29
Gmunden, Austria-Hungary.....	.1
Goodenough, Brit. Columbia.....	34.5
Loch Katrine, Scotland.....	0.096
Michigan, U. S.....	Trace
Mono, Calif.....	45.78
Owens, Calif.....	2.3
Superior, U. S.....	.09
Yellowstone, U. S.....	.4

b. Rivers

Belabula, Clifden Run, N. S. W.....	Trace
Detroit, Michigan.....	1.05
Doubs, at Rivotte.....	.0021
Humbolt, Nev.....	.13
James, Va.....	.0071
Lors, at Orleans.....	.0071

*Aluminum is the life of organisms; Chem Absts. 1922; page 3097.

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Parts per 100,000
Al₂O₃

Mississippi, at Carrollton.....	3.
Mississippi.....	3.13
Neposet, at Hyde Park, Mass.....	.0062
Ottawa, near Montreal.....	Trace
Parana, above La Plata.....	.3
Passaic, N. J.....	1.342
Rhine,	
at Cologne.....	0.0025
at Strassburg.....	0.1
Rhone, at Geneva.....	.0039
Rio Grande.....	0.21
Rio de La Plata, above Buenos Ayres..	.6
Rio Vinagre.....	40.
St. Lawrence, near Vendreuil.....	Trace
Seine, at Bercy.....	.005
Targragar, near Dubbo, N. S. W.....	Trace
Thames, England.....	Trace

c. Springs, Potable

Appolinaris, Germany.....	1.2
Atchison-Parker, Kans.....	.32
Stafford, Conn.....	0.11
Trinkquelle, Driburg.....	0.0106
White Rock, Wis.....	1.07

d. Wells, Potable

Auditorium, Chicago, Artesian well....	0.12
Emperador, Panama.....	2.
Geneseo, Ill., Artesian well.....	14.67
Merrick, L. I.....	8.0

e. Mineral Springs and Wells

Acid Springs, Iowa.....	338.35
Acid Water, Lake White Island, New Zealand.....	931.4

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	Parts per 100,000 Al_2O_3
Alum Spring, Rockbridge Co. Va.....	1241.4
Alum-water, Lee Co., Va.....	89.1
Bethesda Springs, Wis.....	0.21
Blue Lick, Mo.....	17.54
Buffalo Lithia, No. 2, Va.....	3.87
Burr Oak, Kan.....	11.75
Celestine, Vichy.....	1.3
Civillina, Italy.....	45.01
Elizabethenquelle, Baden.....	.07
Geneva Lithia, N. Y.....	4.48
Grande Grille, Vichy.....	18.0
Hot Springs, Ark.....	0.77
Hot Springs, Nev.....	.19
Hunter's Hot Springs, Mont.....	0.23
Jordan Alum Springs, No. 4, Va.....	41.50
Karlsbad Sprudel.....	2.8
Kautavu, Fiji Islands.....	9.09
Kentucky, Alum Springs.....	20.61
Kepuowhara Makia, New Zeland.....	9.20
Londonberry Lithia, N. H.....	2.59
Mt. Clemens Mineral Well, Mich.....	50.55
Oak Orchard Acid No. 1, N. Y.....	6.50
"Old Alum Well," Harrowgate, England	127.8
Old Faithful Geyser, Yellowstone Pk...	.17
Orchard Alum, England.....	9.20
Overall, No. 1. Tex.....	41.83
Rockbridge Alum Spring No. 3, Va....	75.40
St. Clari, Mich.....	1419.3
Saratoga, N. Y. Congress.....	0.55
" " Hathorn.....	0.22
" " High Rock.....	2.10
" " Pavilion.....	0.72
Shenandoah Alum Springs, Va.....	17.84
Sour Lake Mineral Spring, No. 7, Texas	23.31
Tuscarora Sour, Brantford, Conn.....	46.81

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IV. Miscellaneous

	Al ₂ O ₃ %
Edible earth, Fiji.....	41.53
“ “ Japan.....	13.61
“ “ Java.....	25.94
“ “ Lapland.....	40.80
“ “ (Clay) New Zealand.....	17.97

In the Weekly Health Reports, Vol. 29, Part I, Nos. 1-26 1914 p. 1625 is found the following data from an article "Soluble Aluminum Compounds. Their occurrence in certain vegetable products" by C. N. Myers, expert in organic chemistry, and Carl Voegtlin, professor of pharmacology, Hygiene Laboratory, U. S. Public Health Service.

Product	% Aluminum in Product
Whole corn (American)	
{ Maximum.....	0.181
{ Mean.....	.120
{ Minimum.....	.074
Whole corn (foreign).....	.165
Corn oil cake.....	.817
Corn meal.....	.178
Hominy.....	.145
Grits.....	.168
Oat meal.....	.175
Millet.....	.428
Rye.....	.273
Wheat flour.....	.045
Sunflower (hull removed).....	.401
Cottonseed meal.....	.996
Banana, (fresh, peel removed).....	.033
Yams	
Dried.....	.332
Fresh.....	.094
Parsnips	
Dried.....	.306
Fresh.....	.053

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	% Aluminum in Product
Carrots	
Dried.....	.301
Fresh.....	.036
Irish Potatoes	
Dried.....	.126
Fresh.....	.029

	Total Amount of Aluminum in Dry Vege- tables %	Aluminum solu- ble in H ₂ O, di- gested 12 hrs., 37° C. %	Aluminum solu- ble in 0.3 % HCL digested 12 hrs., 37° C. %
Sweet Potatoes....	0.332		0.201
Cottonseed meal..	.996		.718
Millet.....	.428		.171
Corn (whole)....	.115	0.090	.115
Carrots.....	.305	(1)	.312

(1) The carrots used in this determination were a little withered and undoubtedly the amount of dry material was greater than that found in previous water determinations.

The authors state: "In conclusion, it may be said that aluminum is present in certain foods in rather large quantities in a water-soluble form, and that the daily consumption of aluminum on a mainly vegetable diet may assume larger proportions."

Just what these large proportions may be and probably are in one's daily diet may be seen from a study of the following dietary for seven days prepared from preceding data by B. R. Jacobs, formerly in charge of the Cereal Laboratory of the Bureau of Chemistry. It is also of interest to compare the total amount of aluminum consumed in such a diet with the amount that would be consumed from baking powder under average normal conditions.

On page 6 of Bulletin 103, U. S. Dept. of Agr., states that the normal use of biscuits, pastry or other articles leavened with baking powder, as these foods are practically used in the ordinary American family, will not average more than $\frac{1}{4}$ to $\frac{3}{4}$ of a level teaspoon per per-

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son daily, and these amounts correspond to an amount of aluminum of 25 to 75 milligrams of aluminum if a straight sodium aluminum sulphate baking powder were used. A fair sized man will weigh 70 kilos. If he ate food containing S. A. S. baking powder containing aluminum compounds equivalent to 70 milligrams of aluminum this would be at the rate of a milligram per kilo of his body weight. This amount of one milligram of aluminum per kilogram of body weight is called by Dr. E. E. Smith the Referee Board unit or briefly "R. B. unit." The amount of aluminum naturally occurring in baking powder free foods in the following diet, contains nearly 6 R. B. units. In other words, a person eating this diet is eating 6 times more aluminum compounds than he would in the largest ordinary consumption of baking powder.

QUANTITIES FOR ONE PERSON

Day 1

Breakfast

		Grams, as Al PO ₄ in Whole Product
4.6	oz. 1 Baked Apple.....	0.0081
5.4	" 3 Corn meal pancakes.....	1.0941
	(with honey)—Sugar.....	
	Flour.....	
4.2	" 2 Soft boiled eggs.....	.1900
8	" 2 Cups coffee.....	
	Sugar.....	
	Cream.....	
3	" Corn bread.....	.4806

Lunch or Supper

6.3	" 3 Stuffed eggs.....	.2850
1.4	" 2 Slices rye bread.....	.0029
	Banana Salad.....	.2100
5.5	" (with) bananas.....	
0.06	" almonds.....	
1	" cooked salad dressing (flour, vinegar and sugar)	

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			Grams, as Al PO ₄ in Whole Product
5.2 oz.	1	Slice plum cake.....	
		Plums.....	.0048
		Sugar.....	
	30 Gm.	white flour.....	.0060
	1/2	Egg.....	.0470
8	" 2	Cups tea.....	
		with 3 teaspoons sugar.....	
		or	
		Appollinaris water.....	.0002 .0048

Dinner

3.2	" 2	Thick slices roast beef.....	trace
1	"	with 1 helping Yorkshire pudding....	
		1/3 Egg.....	.0320
		30 Grs. flour.....	.02 .0060
3.4	" 1	Serving scalloped corn.....	trace
		1/2 Egg.....	.0470
		Flour.....	
5.8	" 1	Serving fresh parsnip.....	.2385
		or	
		1 Serving dried parsnip.....	.4149
14	" 2	Baked yams.....	1.776
3	"	Egg and tomato salad (1 tomato, 1 egg).....	.0950
		with mayonnaise (1 egg).....	.0950
3.5	" 1	Serving grape Bavarian cream.....	
		Grape juice.....	.0154
		Egg whites.....	.1900
		1500 c.c. water.....	.0016 .0240
Total for day			5.0286

Day 2

Breakfast

7	" 1	Glass grape juice.....	.0154
6	" 1	Dish cream of barley.....	.0012
0.75	"	Sugar.....	
4.2	" 2	Soft boiled eggs.....	.1900

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			Grams, as Al PO ₄ in Whole Product
2.2 oz.	3	Bran muffins with honey.....	.0009
		20 Gm. wheat flour.....	.0040
		Coffee.....	
8	"	Cream.....	
		Sugar.....	
3	"	Corn bread.....	.4806

Lunch or Supper

1.7	"	1 Serving cheese scuffle	
		$\frac{3}{4}$ Egg.....	.0720
		Flour.....	
5	"	3 Blueberry muffins.....	
		Blueberries.....	
		Flour.....	.0134
		Sugar.....	
		$\frac{1}{4}$ Egg.....	.0240
6.9	"	1 $\frac{1}{2}$ Steamed apples.....	.0122

Dinner

4	"	2 Thick slices breast of veal.....	trace
		with 1 large serving bread stuffing	
		$\frac{1}{4}$ Lb. Bread Crumbs.....	.0125
		$\frac{2}{5}$ Egg.....	.0260
2.5	"	1 Serving carrot salad.....	.1154
4	"	2 Serving peas.....	.0028
5.3	"	1 Large baked potato.....	.1998
8	"	1 Serving rice custard.....	
		Rice.....	.0025
		1 Egg.....	.0950
4	"	1 Cup black coffee.....	
		or	
		Appollinaris water.....	.0048
		1500 c.c. water.....	.0240

Total for day 1.2965

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Day 3

Breakfast

			Grams, as Al PO ₄ in Whole Product
4.6	oz.	1 Stewed apple.....	.0081
		Sugar.....	
6.8	"	1 Serving hominy grits.....	.4500
5.6	"	4 Slices French toast.....	.0012
		1/2 Egg.....	.0475
		Sugar.....	
8	"	2 Cups coffee.....	
		Sugar.....	
3	"	Corn bread.....	.4806

Lunch or Supper

8.1	"	2 Servings omelet, 2 eggs.....	.1900
		with rice.....	.0019
		or	
		Peas.....	
2.6	"	4 Bread sticks, 70 gm.....	.0140
		with 3 tablespoons honey.....	.0009
3.5	"	1 Serving grape jello.....	
		Grape juice.....	.0154
		Sugar.....	

Dinner

5.4	"	2 Servings baked beans.....	.0100
6	"	Apple and almond salad.....	
		(with) apple.....	.0081
		almonds.....	
		Mayonnaise (containing 1/2 egg— vinegar).....	.0475
7.7	"	2 Servings buttered beets.....	.1466
2	"	1 Serving Topsy pudding.....	
		1/2 Egg.....	.0475
		Sponge cake (containing 15 oz. flour— 1/2 egg).....	.0500
		57 Gm. wine sauce.....	.0100

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			Grams, as Al PO ₄ in Whole Product
4	oz.	1 Cup black coffee.....	
		1500 c.c. water.....	.0016
			.0240
		Total for day	1.5533

Day 4

Breakfast

9	"	1 Serving preserved strawberries.....	trace
		1 Serving steamed rice.....	.0025
		with sugar.....	
		with cream.....	
		3½ Lb. bread crumb pan cakes.....	
		White flour—½ cup.....	.0060
		Bread crumbs.....	.0250
		Sugar—½ tablespoon.....	
		½ Egg.....	.0475
3.3	"	with honey.....	.0009
8	"	2 Cups coffee.....	
		with sugar.....	
		and cream.....	
3	"	Corn bread.....	.4806

Luncheon or Supper

		Cream dried beef.....	trace
		(Milk).....	
2.4	"	½ T. {Flour.....	.0010
		{Butter.....	
1.4	"	2 Slices on toast at .7 oz.....	.0078
1.7	"	Stewed rhubarb.....	
		Sugar.....	
4	"	Tea.....	
		with sugar.....	

Dinner

8	"	½ Lb. beef tenderloin.....	trace
		½ Lb. scalloped potatoes.....	.1998
8	"	(Milk—½ c.).....	
		10 Gm. (Flour—1 Tbs.).....	.0020

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		Grams, as Al PO ₄ in Whole Product
1.2 oz.	1/4 Cup stewed peas.....	.0020
6.3	" (2) Prickly pear salad.....	
	(6.3 oz.) with Mayonnaise.....	
1.0	" Vinegar.....	
	1/2 Egg.....	.0475
6	" Cherry pudding.....	
	{ 1.2 oz. egg.....	.0475
	{ 1/8 lb. flour.....	.0114
	{ 1/16 lb. sugar.....	
	{ Cherries—2.3 oz.....	.0042
	pg. No. 25.....	
	1500 c.c. water.....	.0240
Total for day		0.9097

Day 5 Breakfast

2.4	" Stewed blueberries (2.4 oz.).....	.0048
6.0	" (1 Tbsp.) corn meal mush (6 oz.).....	.0801
	with grape jelly.....	
.8	" 1 Cup grape juice.....	.0154
	Sugar.....	
5.4	" 2 Poached eggs (5.4 oz.).....	.1900
4	" Coffee.....	
	with sugar.....	
	and cream.....	
3	" Corn bread.....	.4806

Lunch or Supper

8.0	" (1 Orange) orange salad.....	.0121
	with Mayonnaise.....	
	50 Gm. candied orange peel.....	
	Egg—1/2.....	.0475
	Vinegar.....	
	Pepper jam sandwiches.....	
9.0	" { Red peppers—6 oz.....	
	{ Vinegar—2 T.....	trace
5.0	" Cocoa.....	
	{ Milk..... 1 cup.....	
	{ Sugar..... 2 T.....	

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Dinner

		Grams, as Al PO ₄ in Whole Product
2.0	oz. Beef heart (stuffed)	trace
14.0	" Baked sweet potatoes (Yams)	1.776
5.8	" Parsnips (browned in butter)	.4149
	Grape salad	.0007
3.0	" with Mayonnaise	
	$\frac{1}{2}$ Egg	.0475
	Vinegar	trace
2.5	" Currant tarts	
	1500 c.c. water	.0240
Total for day		3.0936

Day 6

Breakfast

9.5	" (3) Mandarin oranges	
6.0	" Cooked farina, $\frac{3}{4}$ c., 6 oz.	.0144
0.5	" 1 t. sugar	
1.8	" Cream	
8.4	" Veal kidneys, stewed, 8.4 oz.	trace
1.4	" On toast (2 slices)	.0078
8.0	" Coffee (2 cups)	
	with sugar	
	and cream	
3.0	" Corn bread	.4806

Luncheon or Supper

12.0	" Turkish rice (T. rice)	.0014
	{ Beef, $\frac{1}{4}$ lb.	
	{ Red peppers, 2 oz.	
	{ Tomatoes, 4 oz.	
2.6	" Bread rolls, 2.6 oz.	.0056
5.0	" (1 Apple) apple salad	.0081
	with Mayonnaise	.0475
4.0	" Tea	
	with sugar	

M O D E R N B A K I N G P O W D E R

Dinner

			Grams, as Al PO ₄ in Whole Product
		2 Creamed eggs.....	.1900
12.0	oz.	Milk, $\frac{1}{2}$ c.....	
		10 Gm. flour, 1 T.....	.0020
		Butter, 1 T.....	
6	"	(2 Medium) browned potatoes.....	.2268
10.5	"	Carrots and.....	.1359
		Peas	
		in Butter.....	
		($\frac{1}{8}$ Lb.) grape.....	.004
8	"	and banana salad.....	.0024
		Mayonnaise	
1.0	"	$\frac{1}{2}$ Egg.....	.0475
		Vinegar.....	
		Chocolate blanc mange	
4.5	"	Milk.....	
		Cocoa.....	
		Sugar.....	
		Egg, $\frac{1}{2}$	.0475
2.0	"	Rye bread.....	
		1500 c.c. water.....	.0240
Total for day			1.2415

Day 7

Breakfast

8	"	(2) Orange juice.....	
6	"	($\frac{2}{3}$ cup) Corn meal gruel, 6 oz.....	.5167
		with sugar.....	
		and butter.....	
4 2	"	(2) Scrambled eggs.....	.1900
1.4	"	on toast (2 slices).....	.0006
4.0	"	Coffee.....	
		with sugar.....	
		and cream.....	
3.0	"	Corn bread.....	.4806

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Luncheon or Supper

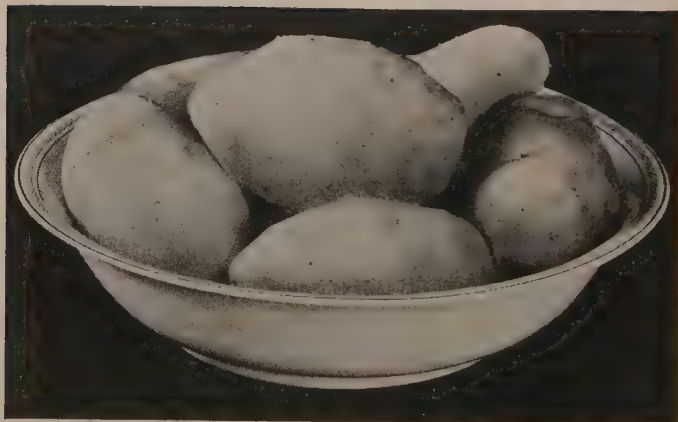
		Grams, as Al PO ₄ in Whole Product
3.0	oz. (½ c.) Fruit salad, 3 oz. including	
	2 T. dressing.....	
	28 Gm. grapes.....	.0002
	1 Apple.....	.0081
	Almonds.....	
	½ Egg.....	
	Mayonnaise, ½ T.....	.0475
8.0	" Parkerhouse rolls.....	.0100
3.3	" Honey (3 T.).....	.0009
5.0	" Milk (1 c.).....	

Dinner

4.6	" Veal steak.....	trace
7.2	" (2 Medium) mashed potatoes.....	.2268
9.2	" (2) Baked apples.....	.0162
	Sugar (2 T.).....	
	Butter (2 T.).....	
	20 Gm. flour (2 T.).....	.0034
10.0	" (½ c.) Stewed carrots.....	.1980
7.0	" Orange.....	
	and green pepper salad.....	
	{ ½ Orange	
	{ ⅓ Green pepper	
	{ ½ Egg	
	{ 2 T. Mayonnaise.....	.0475
	1500 c.c. water.....	.0240

Total for day	1.7705
Grand Total for 7 days.....gms.	14.8937
Equivalent Al.	3.3018
" R.B. units, on the	
assumption of 70 kg. body	
weight (see. p. 71)	6.74

MODERN BAKING POWDER



Potatoes Contain Phosphate and Aluminum

Chapter IX

THE RESIDUES FROM BAKING POWDER

Aluminum compounds naturally occurring in foods are six times as abundant as those present in food from the ordinary use of baking powder. Many of these compounds naturally occurring in foods are in water soluble form and thus more readily available for absorption in the digestive tract than the insoluble forms. The question naturally arises, Are the aluminum compounds left by baking powder soluble or insoluble in water? They are not soluble and hence are not in a condition to be so readily absorbed.

What takes place in the process of cooking is generally looked upon merely as a matter of blending and the actual chemical changes which take place are not thought about. But many changes do take place. Some result in an entire change of the whole ingredient into something else and some result only in a small part of the substance being changed. For instance, take such common ingredients as starch, sugar, fats, protein (white of egg) and salt. Starch is changed by cooking partly into dextrin, a sugar-like substance, and partly into what is known as soluble starch. Sugar is partly changed into invert sugar and partly into caramel and a part remains unchanged. Fats are only partly changed and only by excessive heat. The various nitrogenous foods are acted upon differently by heat, but everyone is familiar with the effect of heat on the white of the egg producing an insoluble substance. Salt on the other hand remains salt in the finished food.

Baking powder itself is a mixture of different substances. The starch and white of egg in baking powder undergo such changes as indicated above. The other ingredients of baking powder are soda, and one or two acid-acting materials. None of these is left in the finished food. They act on each other under the influence

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of water and heat and are completely destroyed. There is no baking powder left, for the soda and acid-acting materials are just as completely changed and destroyed as the chemicals on the tip of a match when it is lighted. Once lighted the match will never light again, for having once done its work it is no longer a match. In a similar manner baking powder gives off its gas



Peas Contain Phosphate and Aluminum

when moistened and heated, but once so spent will never give off gas again, because what is left is no longer baking powder. True, no matter has been destroyed but the active ingredients have been changed into other things. Carbon dioxid gas is one of these things. It is produced by every baking powder. After doing its leavening work it gradually escapes into the air and is soon completely gone from the finished food. It was originally a part of the soda in the baking powder. Everyone appreciates that cooking destroys baking powder as soon as the fact is called to their attention and yet some not stopping to think have the idea that if baking powder is used to leaven food, one must eat the baking powder with the food. This of course is false. Not

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only is there no baking powder left in the finished food, but none of the active ingredients, soda, acid phosphate, sodium aluminum sulphate, tartaric acid or cream of tartar, is left as such. All these active ingredients are changed into carbonic acid gas and other very different substances. Interest in what we eat, therefore, centers around these new substances that are formed, instead of around the original ingredients of the baking powder. One does not eat cream of tartar in food prepared from cream of tartar baking powder; he eats Rochelle salts. Tartaric acid baking powder leaves in the food sodium tartrate, a substance similar to Rochelle salts in its action. Phosphate baking powders leave in the food tri calcium phosphate an insoluble substance which is the chief constituent of bone, and soluble disodium phosphate. Sodium aluminum sulphate powders leave in the food insoluble aluminum hydrate and soluble sodium sulphate. How these are formed is shown by the chemical equations given on pages 69-70, but the same facts may be seen as readily from the following statements.

What we eat as a result of using baking powder as a leavener is accordingly the residue. The residue from cream of tartar or tartaric acid powders is all soluble. The residue from phosphate baking powder is of two kinds, one soluble and one insoluble. S. A. S. baking powders also leave one soluble and one insoluble residue in the food. The percentage of these soluble and insoluble residues left in the food by each kind of powder are given in the following table. These figures are based on baking powders which yield 12 per cent carbon dioxide.

Kind of Powder	Residues	
	Soluble	Insoluble
Cream of Tartar	Rochelle Salts 77.4% (Sodium Potassium Tartrate)	
Tartaric Acid	Sodium Tartrate 26.4%	
Calcium Acid Phosphate	Disodium Phosphate 19.4%	Tri Calcium Phosphate 10.7%
Sodium Aluminum Sulphate	Sodium Sulphate 25.9%	Aluminum Hydrate 7.2%

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Cream of tartar baking powders leave more residue in the food than any other type of baking powders and it is all soluble in water. Moreover, the manufacturers recommend two teaspoonfuls to a quart of flour, while the S. A. S. baking powder manufacturers recommend only one; this added quantity of baking powder doubles the amount of Rochelle salts left in the food. No residue from any other baking powder has ever produced a specific disease. Sodium tartrate, the residue from tartaric acid powders and Rochelle salts, which is sodium potassium tartrate, belong to a class of substances called Tartrates. Of tartrates, The Journal of the American Medical Association states (Vol. LXII, No. 8, Page 617):

“The investigators are agreed on the main features of the action of large doses of tartrates so far as they are observed to cause a pronounced disintegrative action on the epithelium of the kidney in animals. Associated with this there is noted to be a greatly diminished volume of urine and a marked decrease in the elimination of certain of the urinary constituents. The severe renal disturbance may be attended by the excretion of protein and casts when there is not complete anuria. Such sequences are described for various forms of administration of the tartrates, by mouth, intraperitoneally or subcutaneously. According to Underhill and his colleagues, the changes induced in the kidney are confined almost exclusively to the tubular epithelium, and they even believe incidentally that this fact will afford a means of studying various phases of defective renal secretion with practically intact glomerular structure. The Philadelphia investigators, Pearce and Ringer, agree in describing the striking histologic change in the kidney as a defect of the convoluted tubules, with fatty changes in the loops of Henle and sometimes also in the collecting tubules. On the other hand, they report exudative glomerular lesions in about

half of the subjects with severe tubular lesions. In the disintegrative changes taking place, vacuolation that occurs, is rapidly followed by necrosis and finally the dead cells or their debris may entirely fill the lumina of the tubules and form granular and hyaline casts. Neither the liver nor the adrenals exhibit any pathologic defect attributable to the tartrates in such cases."

"The mode of administration to animals does not influence the character of the renal lesion, except that diarrhea, following administration by mouth, may cause rapid removal of the harmful salt from the intestine, and thus prevent the severer types of lesion by reducing the extent of absorption. No strict relation between the dose of tartrate and the extent of damage inflicted has yet been made out. A varying resistance or degree of tolerance seems to hinge on the character of the diet, when tartrate is given by mouth."

Moreover, in considering the unwholesomeness of cream of tartar we must not be misled by the name. It is not a cream in any sense of the word. It is not cream-like in its consistency. It does not rise to the top in the manufacture of wine, but is deposited at the sides of the cask and with the dregs at the bottom. It is not the most wholesome part of the grape but the least wholesome. It is not a food. It gives no heat or nutriment to the body when eaten, but passes through the system unchanged like benzoic acid. The Journal of the American Medical Association, Volume LXII, No. 8, page 616 and 617, in an editorial says:

"Many of the organic acids, like citric and acetic acids are burned up in the body, giving rise to carbon dioxide and water. When their alkali salts are ingested, therefore, the end product of their metabolism is alkali carbonate. It is widely recognized that sodium citrate, for

example, functions precisely like sodium carbonate in the organism. Other organic acids, notably benzoic acid, traverse the body unchanged; in the case here selected the substance introduced reappears, combined with glycocholic acid, in the form of hippuric acid. Physicians have not realized that tartaric acid and its salts are for the most part not destroyed in the body and leave it in their original form. Within the past few months several researches have brought into prominence the fact that tartaric acid and its salts under suitable conditions may give rise to symptoms of nephritis of varying severity.¹

“It would be unwise to magnify the dangers of tartrate in the face of their long use in baking-powders, in the well-known purgative mixtures like Seidlitz powders and Rochelle salt, and their actual occurrence in foods. But when we are reminded that in certain instances of chronic kidney involvement cream-of-tartar water is often prescribed for the promotion of diuresis, and that the use of tartrate purgatives is tending to be overdone in many quarters, it is time to inquire into the possibility of unsuspected dangers. If the benzoates are condemned, shall the tartrates be condoned?”

¹ Underhill, F. P.: The influence of Tartrates on Phlorhizin Diabetes, *Proc. Soc. Exper. Biol. and Med.*, 1912, ix, 123: The influence of Sodium Tartrate on the Elimination of Certain Urinary Constituents during Phlorhizin Diabetes, *Jour. Biol. Chem.*, 1912, xii, 115. Underhill, F. P.: Wells, H. G., and Goldschmidt, S.: Tartrate Nephritis, with Especial Reference to Some of the Conditions under which it May be Produced, *Jour. Exper. Med.*, 1913, xviii, 322. Salant, W., and Smith, C. S.: The Toxicity of Sodium Tartrate with Special Reference to Diet and Tolerance, *Proc. Soc. Exper. Biol. and Med.*, 1913, x, 170. Pearce, R. M., and Ringer, A. I.: A Study of Experimental Nephritis Caused by the Salts of Tartaric Acid, *Jour. Med. Research*, 1913, **xxix**, 57.

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The effect of the soluble residues of baking powder are summarized by Dr. Alonzo Taylor in Bulletin 103 of the U. S. Department of Agriculture, as follows:

“We must not however, be oblivious to the fact,” says Dr. Taylor, who conducted part of these investigations, “that a saline cathartic residue results from the reaction of every form of known baking powder now commonly employed. The use of cream of tartar or tartaric acid baking powder leaves in the alimentary tract a residue of tartrates which exhibit the action of a saline cathartic and of diuresis (excessive excretion of urine) as well. The so-called phosphate baking powder leaves as a residue of reaction sodium phosphate, again a saline cathartic. And aluminum baking powder leaves as a residue of reaction sodium sulphate, a saline cathartic. Apparently therefore, at present at least, the use of baking



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powder is associated with the introduction into the alimentary tract of a certain amount of saline cathartic, the salt differing with the use of the particular type of baking powder."

<i>Type of Powder</i>	<i>Nature of Residue</i>
S. A. S.	Cathartic
Calcium Acid Phosphate	Cathartic
Cream of Tartar	Cathartic and Diuretic
Tartaric Acid	Cathartic and Diuretic

Diuretic action is produced only by tartar baking powders. They are the only ones which act on the kidneys. Cathartics are frequently administered by the mother, but her problem is to control the flow of urine by her children rather than to cause its increase by the administration of cream of tartar and Rochelle salts.

*Wells of the University of Chicago and Underhill of Yale, and others, have found that tartrates injure the kidney causing nephritis. It is only fair to state, however, that the greatest injury to the kidneys is caused by tartrates when injected subcutaneously or intravenously. Only when very large doses are taken by the mouth would such changes occur. Dr. Wm. Post of Rush Medical College thinks that tartrate powders may be used without great danger.

To avoid even the possibility of injury, most manufacturers use S. A. S. instead of cream of tartar in baking powders.

Insoluble residues from baking powder are very different from the soluble ones. They have not the salty taste of the soluble residues and cannot be absorbed into the human system when eaten with food unless they are first dissolved. Because foods do not dissolve in water does not mean that they cannot be dissolved in the digestive tract. We know that many are. Fats, carbohydrates, proteids and mineral salts even though eaten in the form of bread, meat, butter, are utilized in forming blood and later bone and tissue. So these insoluble

* For a complete review of the literature on this subject see Potassium and Tartrates by Ralph W. Webster.

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residues may be taken up by that intricate digestive apparatus provided to man. The question is "Are they?" We know that not all the food eaten is digested. The digestive system seems to be selective in what it takes up to form body material and energy.

We choose what we eat according to opportunity and taste. We eat quantities dependent on tastes, capacity or convention. What has finally entered the stomach is not a supply of different materials proportioned to the body need, but a happy-go-lucky mixture of what was within reach. And here the digestive tract begins to exercise its selective powers and in doing so serves the body in rejecting much that the sense of taste did not reject. The body may absorb what it needs and reject the excessive amounts not essential. Minerals such as lime, phosphate, magnesium, sulphur, silica, fluorine, iodine, iron, etc., are absorbed from the digestive tract in the amounts required and excessive amounts are rejected and passed in the stools. This is true whether the salts are salts of mineral or organic acids. Aluminum hydrate is also to be included with these other minerals. Cream of tartar and Rochelle salts as well as the other common tartrates belong in an entirely different class. The sense of taste is not such as to exclude them from the food eaten though they are not foods. And the digestive organs cannot exclude them. Like poisons in general they are taken into the circulation, carried to the kidneys, which are caused to do excessive work to eliminate them in the urine and when taken in excessive amounts cause that form of kidney disease known as nephritis or Brights disease. On the other hand, we know that the large quantities of aluminum in natural foods, much of it in soluble condition, and the much smaller amount in food due to the use of S. A. S. baking powder are rejected in the digestive tract and the small amounts absorbed (probably essential to life) are in the neighborhood of 1/1000 of 1% of the body weight in a healthy man. Moreover, aluminum salts absorbed into the system have never been known to cause disease to any bodily organ.

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What are the relative amounts of the residues of Rochelle salts and aluminum hydrate found in the foods from the baking powder used? The amount of residues from baking powder that are consumed depend on the per cent of residue produced by the powder and the amount of baking powder used. The per cent produced by each type has already been shown. The amounts used are not the same.

Manufacturers of powders using S. A. S. as an ingredient generally recommend 1 level teaspoonful of baking powder to a cup or 1 heaping spoonful to a quart of flour.

Cream of tartar baking powder manufacturers recommend two. The housewife follows instructions.

A spoonful of baking powder weighs nearly 3.3 grams. Accordingly 1 teaspoonful of legal cream of tartar baking powder leaves a residue of 2.55 grams of Rochelle salts and two teaspoonfuls required for 1 cup of flour leaves 5.10 grams of Rochelle salts in the food.



Parsnips Contain Phosphate and Aluminum

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A spoonful of straight S. A. S. baking powder would leave .23 grams of aluminum hydrate. As only one spoonful is used per cup of flour, this figure .23 grams compared to 5.10 grams shows the relative amount of these residues left in the food from the two baking powders. There is over 21 times as much Rochelle salts in food from a cream of tartar baking powder as there would be of aluminum hydrate if it were prepared with S. A. S. baking powder.

Just as one must use two level teaspoonfuls of cream of tartar powder per cup of flour where combination powders or an S. A. S. powder requires only one; so one must use two pounds of the cream of tartar powder where one would use only one of the combination or of the S. A. S. powder.

Cream of tartar powders sell at 50c per 12 oz. or 66 $\frac{2}{3}$ c per lb. or \$1.33 for two pounds, while the best powders containing Phosphate and S. A. S. can be purchased for 35c per lb. Those using cream of tartar powders pay \$1.33, while those using the Phosphate and S. A. S. type pay only 35c to leaven the same amount of food.

Those paying \$1.33 eat 1.54 lbs. of Rochelle salts in their food, while those paying 35c get no Rochelle salts and only 0.072 lbs. of aluminum hydrate from an S. A. S. powder and still less if they purchase a combination powder.

The question before the public is here plainly presented. It is one of price and residues. The tartrate baking powder people have always taken the price and talked about "alum," but they do not talk about the residue from their own baking powder. They talk, advertise and warn against "alum", but never talk of the residue from their own powder, never even by way of comparison. There is much that can truthfully be said against Rochelle salts and tartrates as compared with the utterly harmless aluminum hydrate. The Baking Powder question (if there be one) is not a question of ingredients but one of resi-

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dues. The public is beginning to recognize this and to appreciate the results of chemical action. The effects of chemical change are seen too often to be ignored. It is known that the effects of striking a match are flame; light and heat, and that the residue is a burnt stick and not a match; that ashes are not coal but the solid residue from its burning; that concrete is not cement, and that we eat no baking powder or baking powder ingredients, but residues which are entirely different.

Baking powders are very common which contain two acid ingredients instead of one. There are in general only two combinations on sale. One contains both cream of tartar and tartaric acid, the other contains Phosphate and S. A. S.

The Tartaric Acid—Cream of Tartar powder leaves two residues, sodium tartrate and Rochelle salts. The Phosphate, S. A. S. powder leaves tri calcium phosphate, disodium phosphate and aluminum phosphate. Aluminum phosphate is insoluble like aluminum hydrate.

The combination Phosphate—S. A. S. powder is the most popular in the United States. Over 70% of the baking powder now used in this country is of this type. This type of powder leaves less aluminum phosphate in the food than there is aluminum hydrate left from a straight S. A. S. powder. The combination type is the best from the standpoint of both price, efficiency and health.

Chapter X

ALUMINUM COMPOUNDS ARE HEALTHFUL AND DESIRABLE CONSTITUENTS OF FOOD

It is but a few years ago that compounds of iodine and fluorine were found to be parts of the human body. Today they are recognized as important and necessary factors in health. Fluorides are constituents of the teeth. Without them the beautiful hard enamel which protects the softer and more easily decayed inner portion of the tooth would be impossible. Fluorine itself is a very poisonous gas. It is an extremely active chemical substance; it even etches glass. This gas can be produced in the laboratory, but it is not found free in nature. Fluorine is always found in combination with other elements. These compounds of fluorine occur in very small quantities in some of our foods.

Compounds of iodine are essential to the normal healthful activity of the thyroid glands. Absence of the necessary amount of iodine results in a diseased condition known as goitre. This is very prevalent in places remote from the oceans. It appears that the air, natural foods and waters distant from the sea, do not supply sufficient iodides to prevent this disease which is especially common to women. It has been proposed to add iodide to the drinking water supplies of our cities, but the solution of the difficulty is better approached by the addition of iodides to common table salt. This prepared mixture is now generally offered for sale by the grocer properly labeled so it can be identified.

Here it is interesting to note that whereas the digestive tract selects some of the food material permitted to enter it by the sense of taste, the different parts and organs of the body exercise a further selective power. The teeth choose the fluoride and other mineral matter, such as calcium and phosphate, but reject the greater part of organic materials which go to make sinew and muscle. The sinews and muscles on the other hand re-

fuse the large percentage of mineral matter. The thyroid selects the iodide which can scarcely be detected in the blood. The blood and the liver utilize or store the iron. Thus the human mechanism is a wondrous thing in its action. It takes the quantities of foods no matter how unknown their composition to the eater, selects parts and rejects parts; it distributes throughout the body the parts first selected to all the other parts of the body each of which to the smallest cell again exercises a selection, taking part and refusing part of what is tendered. The first rejection is emitted mainly as stools and the second in the urine.

From the dietary on pages 74-89 it appears that all our lives we have been entrusting to this human digestive and distributive system six times the amount of aluminum compounds in natural foods that would be derived from baking powder, and the mechanism of the body has handled it without our knowledge and for our well being.

There are several facts now known that point to a conclusion that aluminum compounds are not accidentally in our foods but are essential to human, animal, and plant life.



Veal Contains Phosphate and Aluminum

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The almost universal presence of aluminum in plant life would seem to indicate its usefulness to the plant. As has been stated, it is found most abundantly in the roots, next in the stems, next in the seed and least in the leaf and blossom. (Even the parts of the plant seem to have the power of selecting and choosing the materials best suited to their needs.) The important fact here is that the seeds upon which the perpetuation of the plant species depends contain aluminum. If the presence of the aluminum compound plays a part in the germination and growth of the seed its presence or absence is extremely important. Julius Stoklassa's investigations on the germination of wheat, barley, pea and peppergrass, show that germination as measured by the weight of the rootlets after growth for ten days was increased by aluminum chlorid. In the case of wheat the increase was 11%; in the case of barley, 31%; in the case of the pea 14%; and in the case of peppergrass 41% increase. In the case of the wheat the concentration of the aluminum chlorid was 0.0005 gram-atomic concentration, and in the case of barley, pea and peppergrass 0.0002 gram-atomic concentration. He concludes from his experiments that between 0.0001 and 0.0005 gram-atomic concentration that soluble aluminum compounds act as an activating agent upon germination.

Manganese compounds also hasten seed germination, but are not as effective as aluminum salts. Manganese and iron too are essential to plant growth. Unlike aluminum they are found in the plant especially in the leaves and flowers, entering mostly into the formation of chlorophyll. Stoklassa recognizes all three elements—aluminum, manganese and iron as biogenic factors essential to normal plant growth. Aluminum, manganese and iron compounds are mixed together in the soil whence the plant derives its food. Iron salts are distinctly more toxic to plant life than aluminum. Stoklassa carried on experiments on the growth of wheat, rye, oats, barley and buckwheat without added salts; with added aluminum sulphate; with added iron sulphate and with both iron and aluminum sulphates. The

M O D E R N B A K I N G P O W D E R

following table shows the weights of the dried whole plants produced under these conditions in 72 days, as well as the amounts of iron and aluminum salts used in each case.

Gram-atomic concentration
of Aluminum and Iron
(as sulphates)
-in Nutrient Medium.

		Wheat	Rye	Oats	Barley	Buck- wheat
Aluminum	Iron					
0	0	46.21	80.34	59.05	66.70	20.53
.0005	0	48.33	80.04	61.27	68.19	20.84
0	.0005	45.09	75.33	52.98	66.87	21.01
.0005	.0005	59.42	89.74	69.92	74.15	24.38
.00075	0	50.51	81.66	62.00	67.16	21.97
0	.00075	41.83	72.99	56.04	63.02	19.08
.00075	.00075	56.57	88.83	70.12	75.48	28.29
.001	0	47.83	79.65	59.94	66.82	18.84
0	.001	39.52	68.75	50.02	62.43	16.51
.001	.001	49.77	83.22	63.15	60.10	24.09
.002	0	36.53	60.26	46.25	52.62	11.45
0	.002	30.19	51.05	43.83	50.94	9.30
.002	.002	37.68	60.18	50.72	54.87	14.76
.0005	.002	50.47	72.99	60.23	67.10	20.89

It will be seen from this table that the addition of iron sulphate in any quantity decreased the plant growth in every case except that of barley when the smallest amount of iron salt was used. On the other hand, the plant growth was greater in twelve of the fifteen for an added aluminum sulphate concentration up to and including 0.001. The aluminum begins to show injurious effects beyond this concentration, whereas iron showed injurious effects in 14 of the 15 corresponding growths. An improved growth above that of the controls having neither iron or aluminum salts added was obtained when aluminum sulphate was added

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in a concentration not greater than 0.001. This and similar experiments with manganese, clearly shows as Stoklassa claims "It is clearly shown that the aluminum ions exercise a considerable detoxicating effect on iron compounds." "All of our foregoing experiments have led to the conclusion that neither iron nor manganese are able to exercise a reciprocal detoxication.

The work of Stoklassa and his assistants shows:

1. That aluminum, manganese and iron have a biogenic function in plant life; that they are necessary for plant life.

2. That aluminum acts in at least two ways:

- (a) It activates the process of germination making it more speedy and vigorous.

- (b) It renders iron and manganese non-injurious and makes the transfer of these from the soil to the leaves and flowers where they are needed possible, without retarding seed germination or plant growth.

3. That iron which has long been known to be necessary to plant and animal life is much more injurious to plant life by itself than is aluminum by itself.

4. That in amounts exceeding those that are of value in plant germination and growth, each of these metals is injurious to plant life.

House and Geis experimenting with the common bean also found that small amounts of aluminum salts were stimulating and in large amounts injurious to plant growth. Other scientists have noted this stimulating effect on seed growth. Stoklassa fed his plants, i. e., the roots were in nutrient solution. House and Geis starved their plants keeping the roots in pure water to which only the aluminum salt was added. The fact that the aluminum salts ceased being beneficial at a different point of concentration in the different experiments is to be expected from the different mode of treatment.

E. E. Smith states:*

"An interesting side light on the biogenic function of aluminum in plant life is its dis-

* Aluminum Compounds in Food page 182.

tribution as related to its functional activity. From the data already presented, it appears that its occurrence in plants is by far the greatest in seeds and in roots, etc. That is to say, it is most abundant in those parts where it exercises its biogenic functions. It is fair to believe that this is not a mere accident, but a provision in nature to supply to these parts the chemical elements useful and essential for plant germination and the reciprocal detoxication of absorbed iron and manganese which elements are necessary to the constitution of the chlorophyll structures essential to plant life."

It is also important to remember that different kinds of plants require more or less aluminum, dependent on their kind and the conditions under which they grow.

"*Plants that grow under conditions of minimum water supply (xerophytes), including such varieties of rock-brake, Solomon's seal, Bohemian iris, feather-grass, knot-weed, corn spurry, alyssium, gentian, rib-grass, naturally

* Aluminum Compound in Food page 179.



Beef Contains Phosphate and Aluminum

took up very little aluminum and did not tolerate it well.

“On the other hand, plants growing in their natural habitat under conditions supplying unusually large quantities of water (Hydrophytes), including certain ferns (bladder, flowering), grasses (reed, manna, cane), sedge and certain flowers (lily of the valley, buttercup, marsh marigold, cransbill, sage, calt’s foot) absorbed and tolerated aluminum even up to a gramatomic concentration of 0.006 without injury.”

In animal life the indications that aluminum salts are necessary are just as strong as in the case of plants. Aluminum is found in the hen’s egg in comparatively large quantities. It is found in the milk of the cow and in human milk, which is food for the young. Added aluminum salts have been found to accelerate the healthful growth of animals and to increase the production of young. All these investigations have been begun in comparatively recent years. Previous attempts were without value because sufficiently accurate methods of analysis were unknown. With increased knowledge of the beneficial effects of extremely small quantities of such mineral matter as fluorine and iodine, research has been stimulated to investigate the function of very small quantities of other things. Aluminum compounds are among the first to excite the interest.

Osborne and Mendel* have found aluminum, fluorine and manganese in cow’s milk and have added these in the proportions found to purified rations in animal experimentation.

Ruhrh† lauds the value of soy-bean milk mixtures in cases of undernutrition in infants. Soy-bean contains aluminum and silicon so the soy-bean milk mixture is a double source of aluminum. Experiments on rats by Professor Daniels and her assistants show that milk

*Osborne, T. B. and Mendel, L. B., *J. Biol. Chem.* 1913, XV, 311.

†Ruhrh, J., *J. Am. Med. Assn.*, 1910, liv, 1664.

alone is not a complete food for the rats fail to reproduce. On the other hand, rats fed only on milk to which the ash of soy-bean is added, do reproduce. When the mineral salts found in milk and soy-bean are added to milk, rats grow well and reproduce well. She found that aluminum and silicate seem to be necessary additions; that while manganese and fluorine appeared to be toxic when added alone, they may be necessary for physiological processes. Manganese and fluorine seem to have been detoxicated by the addition of aluminum and silicate, as is shown by the fertility of rats fed milk and all four of these minerals. This detoxication of manganese and fluorine finds its like in the part played by aluminum in plant life, as noted by Stoklassa.

The report of Daniels and Hutton of this investigation, which was started several years ago at the University of Wisconsin and finished at the University of Iowa, is summarized more fully at the end of this chapter.

The reports of aluminum in the dog, rabbit, rat, birds, and in man are indicative of its normal presence in all animal life. The crudeness of the chemical methods involved throw doubt on the actual amounts but not on its presence.

German scientists report the presence of considerable aluminum compounds in infants' bodies. This, in connection with the occurrence of aluminum in mothers' milk, seems to show a special provision for the child of this mineral in the early portion of its existence.

As indicated earlier in this chapter, a fuller statement of the investigations conducted by Amy L. Daniels and Mary K. Hutton will be given here. This work is published in full in the *Journal of Biological Chemistry* Vol. LXIII, No. 1, February, 1925, as a contribution "From the Department of Nutrition, Child Welfare Research Station, State University of Iowa, Iowa City." It is entitled, "Mineral Deficiencies of Milk as shown by Growth and Fertility of White Rats."

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*The authors had observed that 'rats fed exclusively on milk, either raw or quickly boiled, seldom reproduced' and 'where reproduction did take place, the young in general were born late and only a very small percentage survived the suckling period. A third generation on milk alone was never raised.' This suggested that milk was deficient in substances essential to normal physiological processes.

Similar results were obtained with whole milk powder. Supplementing milk with such substances as cereal diluenta, wheat embryo extract, lactose, beef extract, corn-starch, cod liver oil, and later, cystine, and various calcium salts, failed to improve the nutritive value of milk. With the addition of iron citrate, the number of fertile animals was somewhat higher, yet considerably below normal and the third generation never reproduced. With the further addition of iodine slightly better results were obtained, with one group a fourth generation being produced which grew normally for 3 months and then only very slowly and failed to further reproduce. Considered as a whole, there was no uniformity, either in fertility or in the number and viability of the young.

The report of Ruhräh, lauding the value of soy-bean-milk mixtures in cases of undernutrition in infants, suggested its trial. The addition of 7 to 10 grams of soy-bean-powder, cooked, and added to 1 liter of boiled milk, produced surprising results. Young in the first generation of rats were obtained in 13 weeks; second and third litters followed in quick succession; and these in turn bore young which were successfully raised. Animals were then

* Summary by E. E. Smith. Aluminum Compounds in Food page 293.

fed milk to which the ash of soy beans had been added. All females in the first generation were fertile, the first litters being born before the age of 6 months (which time was the standard adopted for fertility measurement and number of young born), were normal in number and the individuals of average size. Moreover, 76 per cent of these young were successfully suckled. With milk alone in the first generation only 12.5% of the females were fertile up to 6 months, few young were born and none of those lived. In the second generation on milk alone only one of five females was fertile up to 6 months and none of the five young born in this group was raised. In contrast to this, the ten females of the second generation on the soy bean ash-milk mixture produced 67 young, all of which were raised. In the three successive generations on milk and soy bean ash, an average of 6.3 young per female up to 6 months was successfully suckled.

“An analysis of the soy bean ash showed that aluminum and silicon were present. Osborne and Mendel had reported significant traces of aluminum, fluorine and manganese in milk and had incorporated those in their purified rations in the proportions found. It seemed possible that some or all of these might be essential to physiological processes and, although they were present in cow's milk, might be in too small concentration for reproduction and rearing of the young of the particular species of animal under investigation. Since silicon was found in all vegetable and in some animal tissues, it was thought that this also might be essential to physiological processes.

“Accordingly, a thick starch paste, containing a mixture of aluminum potassium sulphate ($\text{AlK}(\text{SO}_4)2.12\text{H}_2\text{O}$), sodium fluoride (NaF),

sodium silicate Na_2SiO_3) and manganese sulphate ($\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$) was added to milk in such a proportion that each animal received daily 1.5 mgs. of each salt, a purely arbitrary amount. One drop of a 2 per cent solution of sodium iodide and 3 drops of a saturated solution of iron citrate was further added to each 200 cc. of the milk.

“On milk thus supplemented with these four mineral constituents, the rats developed admirably; young were born between the 14th and 16th weeks, were vigorous and developed normally. In each succeeding generation, all females were fertile, first litters being produced early and a large proportion of the young was raised, an average of 80 per cent in the five generations. Six generations were produced with every indication of continued growth and reproduction. Two females of the sixth generation bore young at $3\frac{1}{2}$ and $3\frac{3}{4}$ months, respectively. From these results, it seemed that the substances lacking in milk were included in the above mixture of four salts.

“That all substances necessary for normal growth and reproduction were in milk, but in too low concentration, seemed evident, not only from the work of Daniels and Hutton, but from that of Anderegg and of Mattill, Carman and Calyton. In both of these investigations, animals fed milk low in fat did not exhibit marked reproductive failure. Apparently when more milk was taken, as would be the case in rats fed a low fat milk, enough of the various essential substance was obtained for the production of a next generation.

“Trials were then made by Daniels and Hutton with the separate salts above named and combinations of two and more, iron and iodine as well being constantly added to the whole milk. In evaluating the results, the high mor-

talities of the young in the successive generations of many groups, even when fertility was high, led to the conclusion that the average number per female of young raised within a six months period was a better criterion of the potency of the added salts than was the fertility. Judged by this standard, the animals receiving the mixture of the four salts out-classed all the other groups.

"The addition of aluminum ($\text{AlK}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$) in one series and of sodium silicate (Na_2SiO_3) in another resulted in a higher percentage of fertile animals and a fair number of viable young through three generations.

When these two salts were used together, all females in the first and third generations were fertile, whereas those in the second and fifth reproduced very late. With the exception of the first, the number of the viable young in each generation was very low. The addition of either manganese or fluorine to the aluminum and silicate mixture resulted in a high percentage of fertility and a fair number of viable young. Whether manganese or fluorine was essential was not clear. Alone in the concentrations used, they appeared to be toxic. Combinations of aluminum and manganese and of aluminum and fluorine were also unsuccessful. In neither case were there young in the first generation. A combination of aluminum, manganese and fluorine however, carried on to the fifth generation. With the exception of the fourth generation, fertility in those was slightly below normal, and the number of viable young was considerably below the average in each generation.

Aluminum and sodium silicate appeared to be necessary. These, however, must both have been so incorporated in the diets that they were both available. The happy results produced

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where manganese and fluorine were added to the aluminum and silicate mixture might have been due to the fact that the aluminum and silicate were thus made more readily available; on the other hand, traces of manganese and fluorine might have been necessary for physiological processes.



Eggs Contain Phosphate and Aluminum

Mitchell & Schmidt* of the Nutrition Laboratory, Battle Creek Sanitarium and College, call attention to the increased reproduction in the case of anemic rats by their use of the facts set forth by Daniels and Hutton. They were studying the Relation of Iron from Various Sources to Nutritional Anemia.

They found that second generation rats on low iron diets such as milk, or white bread and milk, were extremely anemic. The difficulty was that the number of young so produced of proper vitality for experimentation was not sufficient.

“A suggested solution to our problem of reproduction on milk diets came in the report of Daniels and Hutton¹¹ showing the beneficial results obtained by adding traces of certain minerals to the milk. This effect was most evident in promoting better reproduction and survival of the young. The best results were obtained when all six minerals mentioned were added, but their findings indicated definite beneficial effects when only four or five of the salts were added. Consequently, since the production of anemic rats was our object, *the iron was withheld* but the five other salts of manganese, fluorine, silicon, aluminum, and iodine were added to the milk in the quantities as indicated by Daniels and Hutton.¹¹

“Our records indicated a decided improvement in reproduction directly following the addition, but better weather conditions at that same period may have been a contributing factor. The fact remains, however, that sufficient young survived to permit starting an extensive series of experiments. The addition to the milk of the mineral solution as modified for our purpose became a routine procedure for all of the milk-fed breeding stock, and later for all of the rats on experimental diets.”

*J. Biol. Chem. LXX: No. 2, page 471, October, 1926.

Chapter XI

SCIENCE AND PRACTICAL EXPERIENCE AGREE

Aluminum compounds are present in our natural foods. Many of these compounds are present in a soluble condition. Yet those attempting to prove that aluminum compounds are deleterious, claim that aluminum is not normally present in the human body, and that these soluble compounds naturally in food are not absorbed by the human system. They also claim that the insoluble residues of aluminum compounds from baking powder are partly dissolved by the hydrochloric acid in the digestive juices. They even insist that they are so dissolved and have made many experiments trying to prove it. They consider that it must be in solution before it can be absorbed and become injurious. They claim that aluminum baking powder residues are absorbed. But it is unreasonable to suppose that insoluble aluminum compounds dissolved in the hydrochloric acid of the gastric juices are any more easily absorbed than the already soluble aluminum compounds naturally present in the food.

It was only a few years ago that some physicians claimed that only the mineral salts as found in foods were absorbed and that added mineral salts such as mineral phosphates were not utilizable as food by the body. That idea has been exploded, but we are surprised to find men of seemingly normal mentality now assuming the opposite, i. e., that the alumina in foods even though soluble is not normally absorbed by the human system, but that the insoluble alumina from baking powder is absorbed.

Geis evidently assumed in his earlier work that aluminum was not present in the dog, but subsequent work done under his direction by Balls showed this to be false. Balls states "In this case the blood undoubtedly contained aluminum, the presence of which was confirmed

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by the qualitative tests described later.” * * * * “It is reasonable to suppose that most of the elements could be found in living matter if our means for their detection were delicate enough.” It is reasonable, especially in view of the fact that aluminum is found in mothers’ milk and the human body as already mentioned. Gray found that a dog not fed added aluminum compounds contained aluminum widely distributed in its organs (1 to 21 parts aluminum per million).

The selection of the term “protoplasmic poison” as applied to aluminum compounds by those who wish to encourage the use of tartrate powders and discredit the use of S. A. S. powders, is a mere trick of words. Almost everything is a protoplasmic poison: Sugar is; so is salt; so is cream of tartar, and also tartaric acid.

In a sense, the essential constituents of protoplasm itself are protoplasmic poisons. Certainly the deliberate selection of this term has been only one of the unfair means used to create suspicion of what in reality is a most meritorious product.



Chestnuts Contain Phosphate and Aluminum

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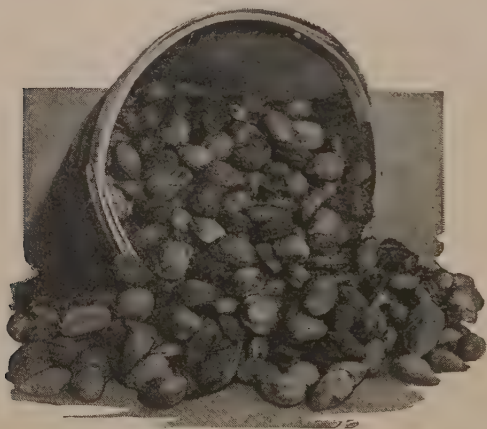
Subcutaneous and intravenous injections have been used in the past to study the possible effects of the same substance taken by mouth. The advantage of these methods lies in placing the quantity of substance desired more immediately in the blood stream to be carried to all parts of the body and the more immediate production of the effect deleterious or otherwise to the organs and parts so reached.

There are disadvantages as well. Any foreign material, even distilled water, placed suddenly in the circulation in this manner is out of place, disturbs the quantitative relations of the component parts of the blood and hence produces injuries to the body. By these methods it is expected that any injury to any part of the body other than the digestive tract by the same substance taken by mouth would be one of the injuries shown by such injection. In other words, this method aims to show what injuries are to be looked for if any. This method does not show that the substance injected ever does get into the circulation when the material is taken by mouth, but only shows what injury might be inflicted if that amount were taken into the circulation after oral ingestion. This method sets aside the protective and selective mechanisms of the digestive tract and puts the material into the circulation whether those mechanisms, if given the ordinary opportunity to act, would allow them to enter or not. After the study of an experiment by these methods of injection, it is necessary to feed the material in the ordinary manner by mouth to see which if any of the injuries by the other method are in fact produced. Injuries produced by the subcutaneous injection of lemon or orange juice would be painful but would not show these were harmful foods, unless feeding experiments produced like ill effects. This injection method has been applied to baking powder problems. Injections of tartrates have produced injury, especially to the kidney, causing nephritis. Feeding experiments have shown that large quantities of tartrates also cause this injury.

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Injections of aluminum salts have produced injury, but despite careful investigation, such injury has never been found to occur from oral feeding.

The selective and protective mechanisms of the body are sufficient in the case of aluminum salts. Whether insoluble aluminum residues from S. A. S. baking powder are partly dissolved in the digestive tract does not matter. They do no injury while there and experiments have shown that the small quantities absorbed do no injury but are probably necessary. The amounts absorbed are exceedingly small, amounting at most to fractions of a thousandth of one per cent as Al_2O_3 . When we consider that we are taking $1\frac{1}{2}$ lbs. alumina



Almonds Contain Phosphate and Aluminum

in our natural foods every year of our lives, an equivalent to 1% of our body weight, and that analyses* of blood taken from grown healthy men fed on natural foods and S. A. S. baking powder food for years, show only from seven to thirteen hundredths of one thou-

* W. G. Hilpert, P. 233-234—Aluminum Compounds in Food by E. E. Smith.

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sandth of one per cent, we are sure that aluminum does not accumulate in the body. Assuming that the whole body did not average a greater per cent of alumina than the blood, then the selective and protective mechanism of the body has excluded from the circulation more than 999 times as much alumina as was taken during a single year in the food from every source, and all that was taken during previous years. The men were healthy and strong; this little bit of alumina showed no signs of injury. It is very apparent that the human system absorbs very little even of the soluble aluminum compounds found in vegetable foods. The body evidently appropriates only what it needs.

With evidence so strong that aluminum compounds are desirable, we must nevertheless, call attention to the rat feeding experiments of Geis; these experiments were planned by Geis and carried out by his assistants with money furnished by the tartrate interests. In regard to these experiments, Smith, E. E., Steenbock and Mendel have all testified that the rats were undernourished and that what Geis described as effects of aluminum were in reality the effects of malnutrition due to the defective diet. We do not need to go into all the details of that. Geis' experiment was so patently unfair in the most important particular. His principal comparison was between rats fed principally on biscuits made with tartrate powder and rats fed on biscuits made with S. A. S. powder. That sounds rather fair, but he did not use relatively the same amounts of powder as are customarily used of the two types or as recommended by the manufacturers. He used two and a fraction times the amount of powder recommended by the tartrate manufacturer and five and a fraction times the amount recommended by the S. A. S. manufacturer; in round numbers the multiples were 3 times the tartrate and 6 times the S. A. S. powder. Geis was not interested in showing the relative effects of the same weight of tartrate residue as against the same weight of aluminum residue. That would serve no purpose for

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that is not the proportion in which they are used. The proportion in which they are used every day by the housewife, the same proportions that are recommended by the manufacturer, these are the ones that should have been used to make a fair comparison. If he chose



Trees and Grasses Contain Phosphate and Aluminum

to use six times the customary amount of S. A. S. baking powder, he should have used six times the customary amount of tartrate powder. That the S. A. S. rats grew less than the tartrate rats when fed biscuits made with six times the amount of baking powder usually employed as compared with the tartrate rats eating bis-

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cuits made with only three times the amount of baking powder usually employed is readily explained by the fact that the S. A. S. rats didn't like the taste of the biscuit with six times the proper amount of baking powder well enough to eat as much as the tartrate rats ate of the tartrate biscuits with only three times the usual amount of powder in them.

Geis claimed there was no objectionable taste to these S. A. S. biscuits. If Geis was right as to the taste, that six level teaspoonfuls of S. A. S. baking powder to a cup of flour do not give a taste to the food, why all this cry of "No Bitter Taste."

With all the hired experts employed, no one has ever been able to prove that aluminum compounds as used in foods were, or even probably were, deleterious to health. The consensus of opinion from all investigations by disinterested scientists is to the contrary. The most extended investigation, and the most costly, of the effects of aluminum compounds as used in food on the health, was conducted by the U. S. Government. It was done through a Board appointed by order of President Roosevelt and composed of men selected by him personally. No other investigation of this subject was ever undertaken in any such complete manner by any individual, firm or government. No investigations have since been published which throw any doubt on the accuracy of their conclusions. The details of the investigation which led to their final conclusions and report have never been published. In their present typewritten form they fill a trunk. The U. S. Department of Agriculture has published a brief statement of the investigation, together with the questions asked the Board and their answers and conclusions. Their conclusion was that S. A. S. baking powders are no more harmful than any other baking powder.

In the year 1899 the court in rendering its decision in the Layton case stated:

“*Upon cross-examination the experts testifying for the prosecution admitted that in all their experience and in all their reading and information that they possessed on the subject they had never themselves come in contact with, nor could they obtain any information or any knowledge of any recorded instances in which functional disorders or disease or impairment of the digestion and general health had resulted to any human being from the use of alum baking powder as an ingredient in the preparation of food.

“In the mind of the court this fact, considering the enormous proportions to which the alum baking powder industry has grown in this country, and the length of time in which such baking powders have been in use, stands as a stone wall against the deductions of the most eminent scientists who presented their theories on the part of the prosecution. I am unable to find in the evidence in this case any just ground for a ruling that alum baking powders of themselves, when used in the preparation of food are in anywise less wholesome than any other variety of baking powders.”

These last words of the court carry the same story as the last paragraph of Bulletin 103. Since that time the use of baking powder containing S. A. S. has become even more general. There has yet to be shown a single case of food prepared with S. A. S. baking powder being in any way deleterious or injurious. There are today in the United States alone more than eighty million healthy, happy consumers of foods prepared with baking powder containing aluminum compounds. Baking

* Baking Powder Controversy page 703.

EFFICIENT AND HEALTHFUL

powders containing S. A. S. are healthful; they are efficient; they are economical. The popular choice of a combination Phosphate—S. A. S. baking powder is a verdict of the American people in harmony with scientific findings.

The combination baking powder is the modern baking powder, tested and approved as wholesome and efficient by scientists and by 40 years actual use in the American home.

The end.

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